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(12) **United States Patent**
Snow

(10) **Patent No.: US 11,477,271 B2**
(45) **Date of Patent: *Oct. 18, 2022**

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(54) **LOAD BALANCING IN BLOCKCHAIN ENVIRONMENTS**

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(72) Inventor: **Paul Snow**, Austin, TX (US)

(73) Assignee: **Inveniam Capital Partners, Inc.**, New York, NY (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **17/448,942**

(22) Filed: **Sep. 27, 2021**

(65) **Prior Publication Data**

US 2022/0030054 A1 Jan. 27, 2022

Related U.S. Application Data

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G06F 15/173 (2006.01)
H04L 67/1001 (2022.01)
(Continued)

(52) **U.S. Cl.**
CPC ***H04L 67/1001*** (2022.05); ***G06F 9/45558*** (2013.01); ***G06F 16/1805*** (2019.01);
(Continued)

(58) **Field of Classification Search**
CPC H04L 67/1004; H04L 67/1002; H04L 9/0643; H04L 2209/38; H04L 2209/56; G06F 9/45558
See application file for complete search history.

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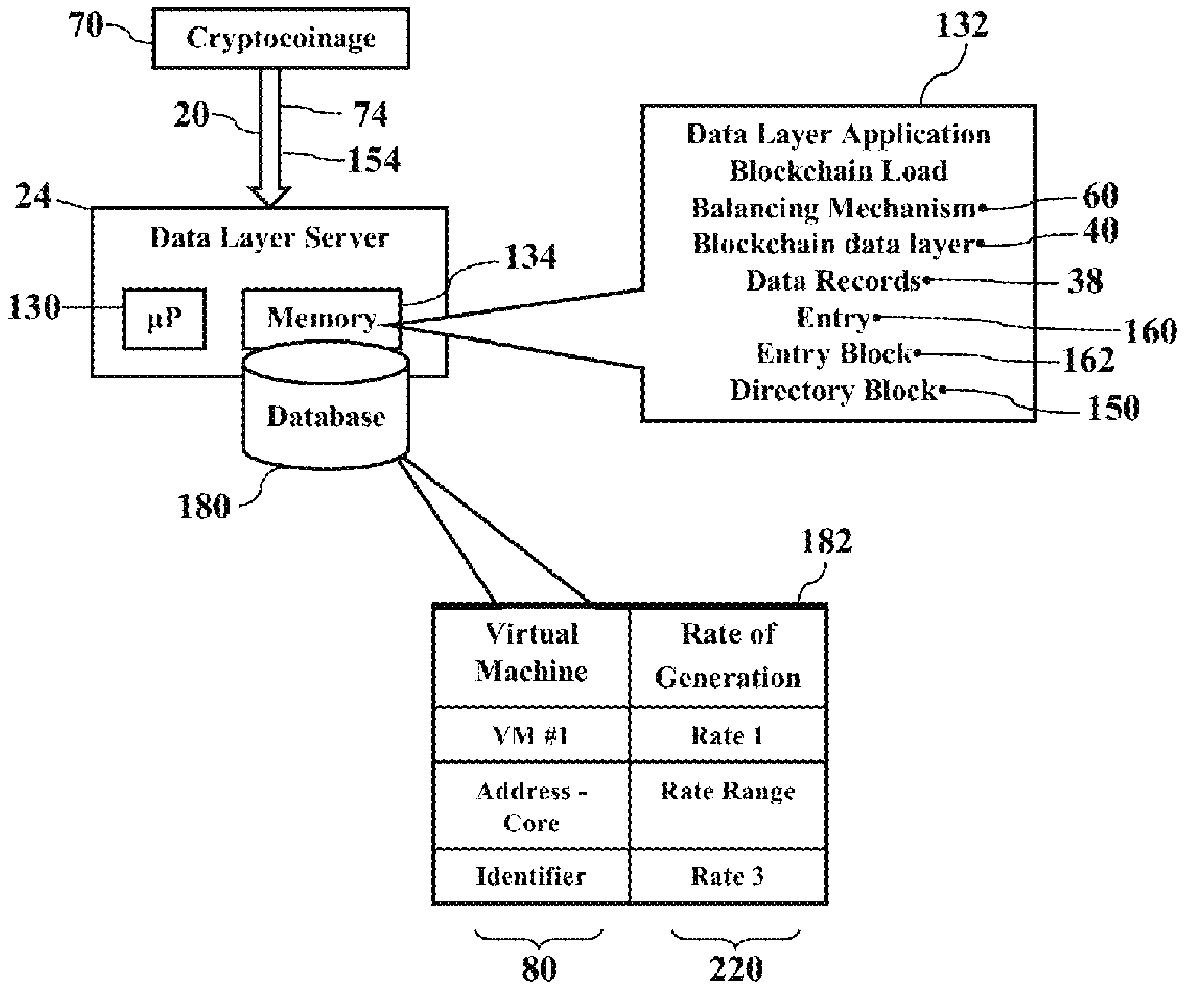
Primary Examiner — Oleg Survillo
(74) *Attorney, Agent, or Firm* — Koffsky Schwalb LLC

(57) **ABSTRACT**

Hardware and software resources are load balanced when processing multiple blockchains. As more and more entities (whether public or private) are expected to generate their own blockchains for verification, a server or other resource in a blockchain environment may be over utilized. For example, as banks, websites, and retailers issue their own private cryptocoinage, the number of financial transactions may clog or hog networking and/or hardware resources. A blockchain load balancing mechanism thus allocates resources among the multiple blockchains.

20 Claims, 29 Drawing Sheets



Virtual Machine	Rate of Generation
VM #1	Rate 1
Address - Core	Rate Range
Identifier	Rate 3

(51) **Int. Cl.**
H04L 9/06 (2006.01)
G06F 9/455 (2018.01)
G06F 16/27 (2019.01)
G06F 16/18 (2019.01)
H04L 9/00 (2022.01)

(52) **U.S. Cl.**
CPC ***G06F 16/27*** (2019.01); ***H04L 9/0643*** (2013.01); *H04L 9/50* (2022.05); *H04L 2209/56* (2013.01)

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FIG. 1

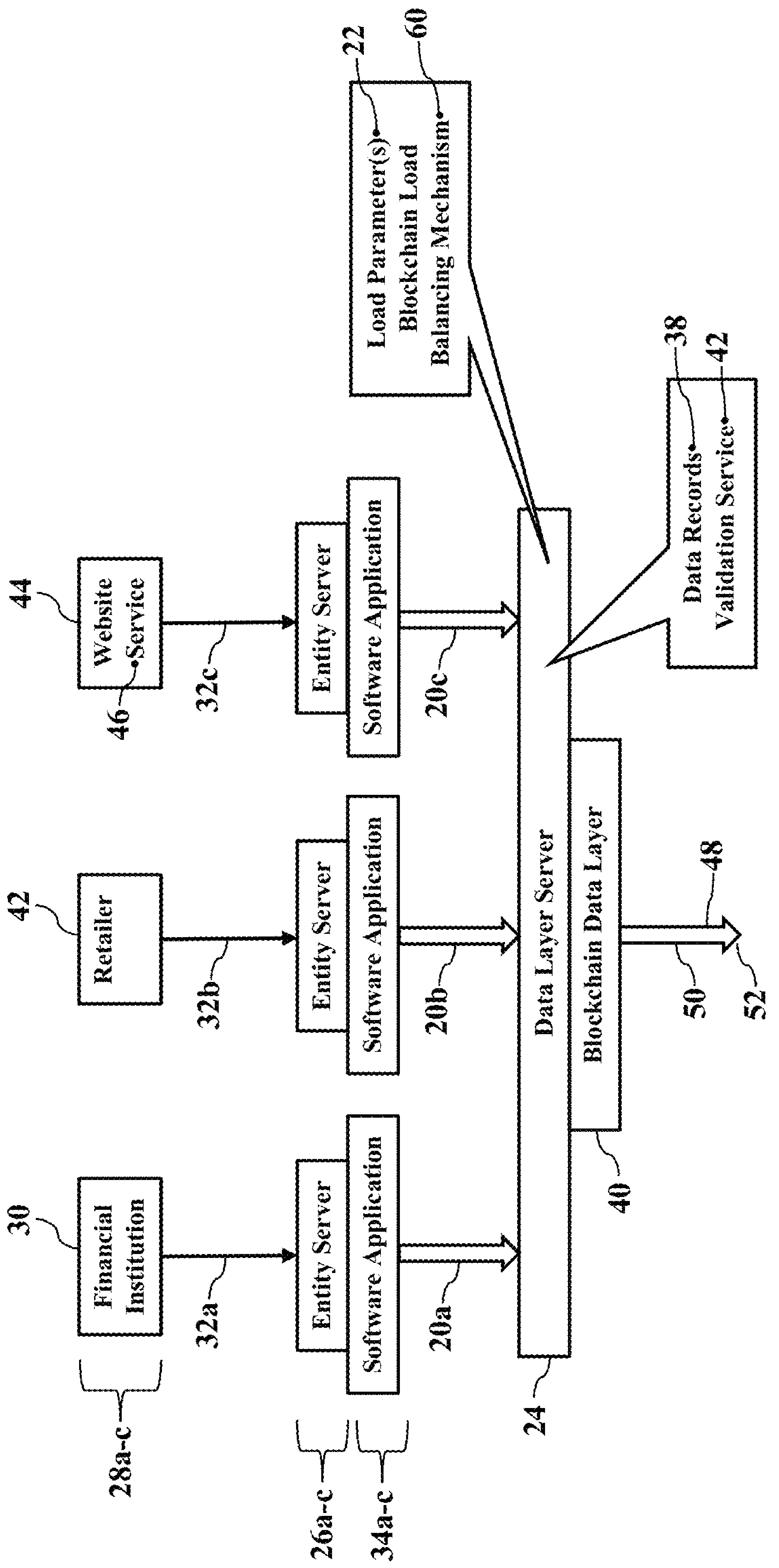
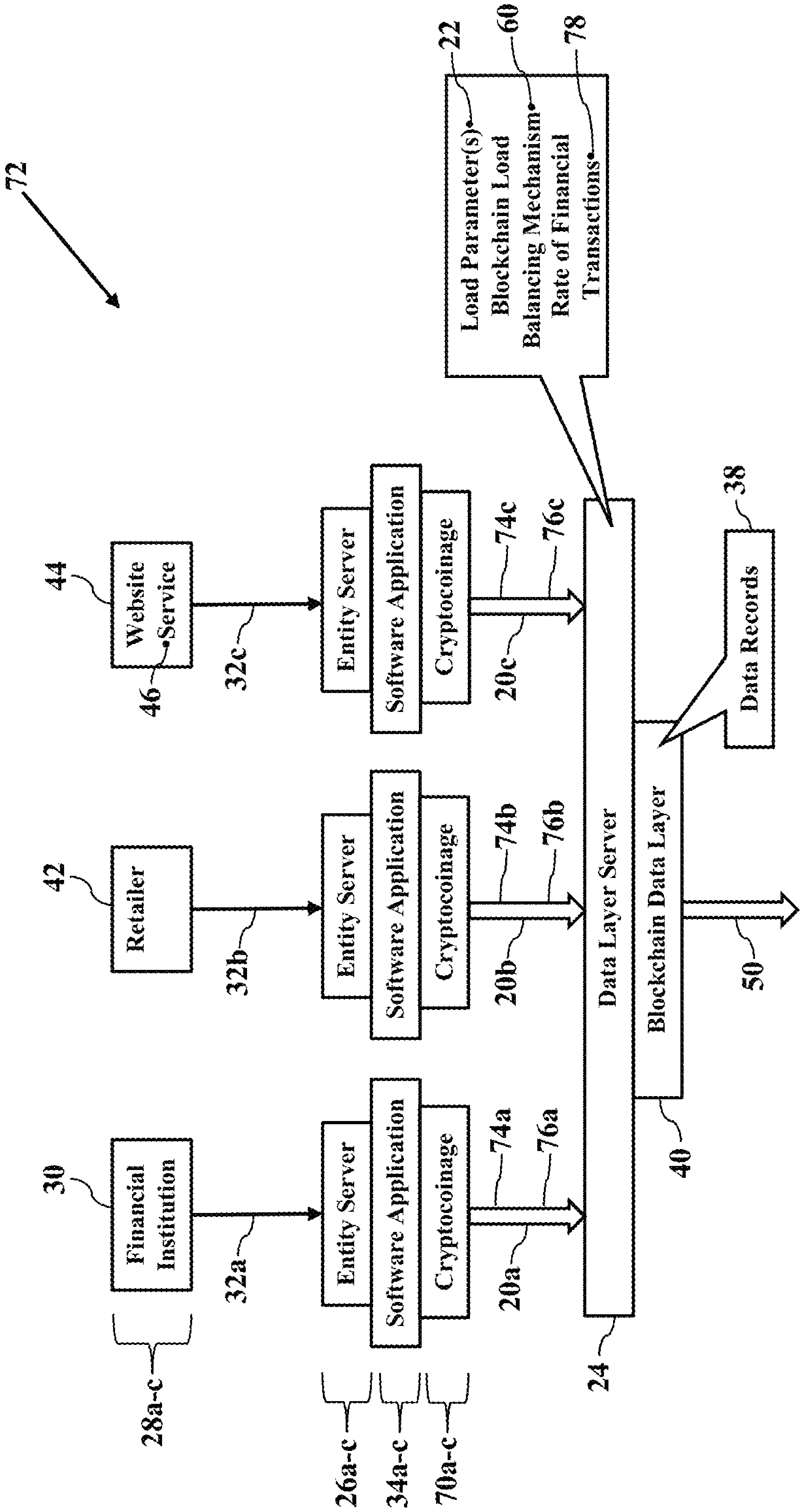

28a-c
30
Financial Institution
32a
26a-c
34a-c
Entity Server
Software Application
20a
24
42
Retailer
32b
Entity Server
Software Application
20b
Data Layer Server
Blockchain Data Layer
40
48
50
52
44
Website Service
46
32c
Entity Server
Software Application
20c
22
60
Load Parameter(s)
Blockchain Load Balancing Mechanism
38
42
Data Records
Validation Service

FIG. 2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Retailer
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Website Service
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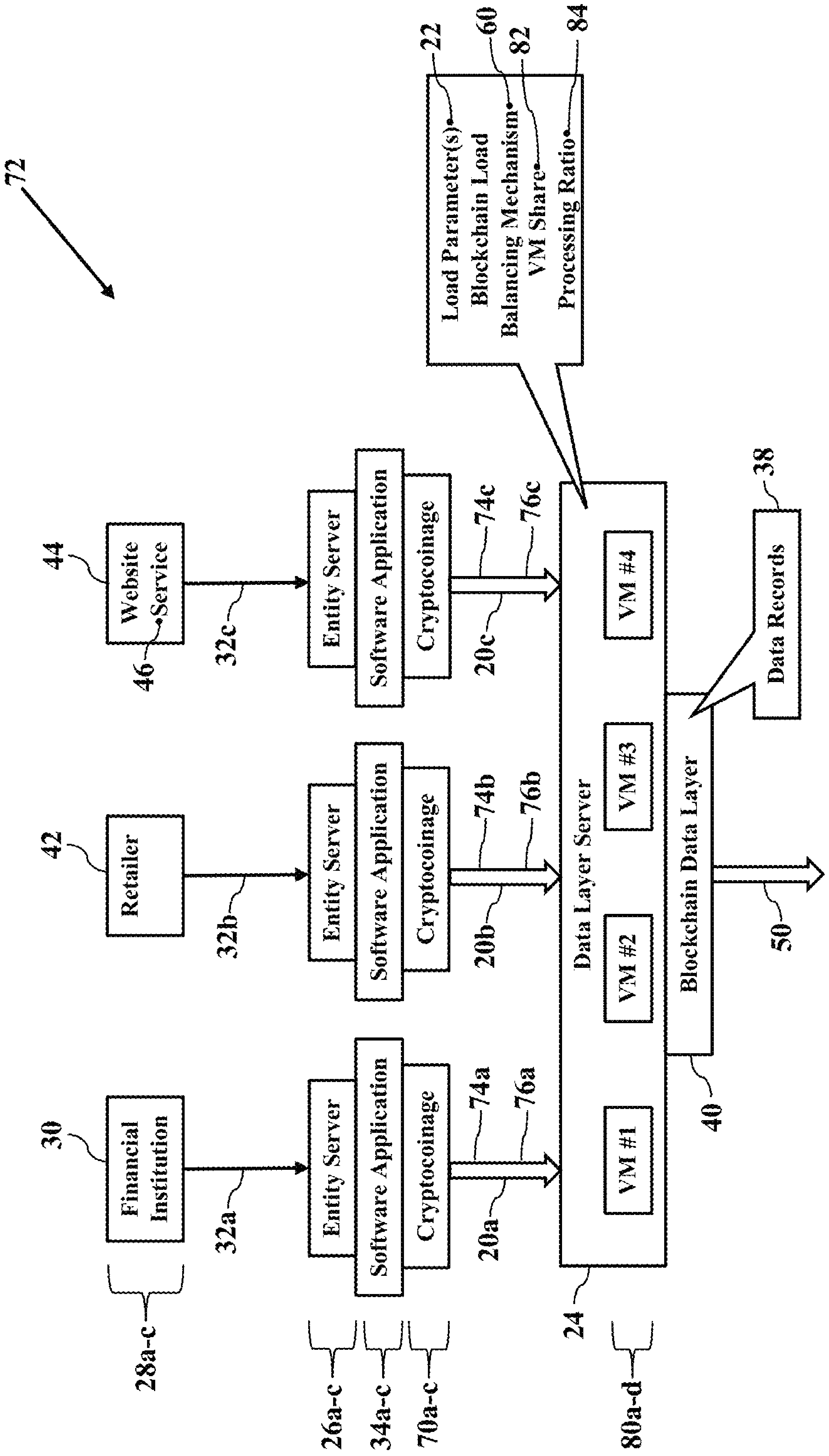
Entity Server
Software Application
Cryptocoinage
26a-c
34a-c
70a-c
20a
20b
20c
74a
76a
74b
76b
74c
76c
Data Layer Server
24
Blockchain Data Layer
40
50
Data Records
38
Load Parameter(s)
Blockchain Load Balancing Mechanism
Rate of Financial Transactions
22
60
78

FIG. 3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Financial Institution
30
Retailer
42
Website Service
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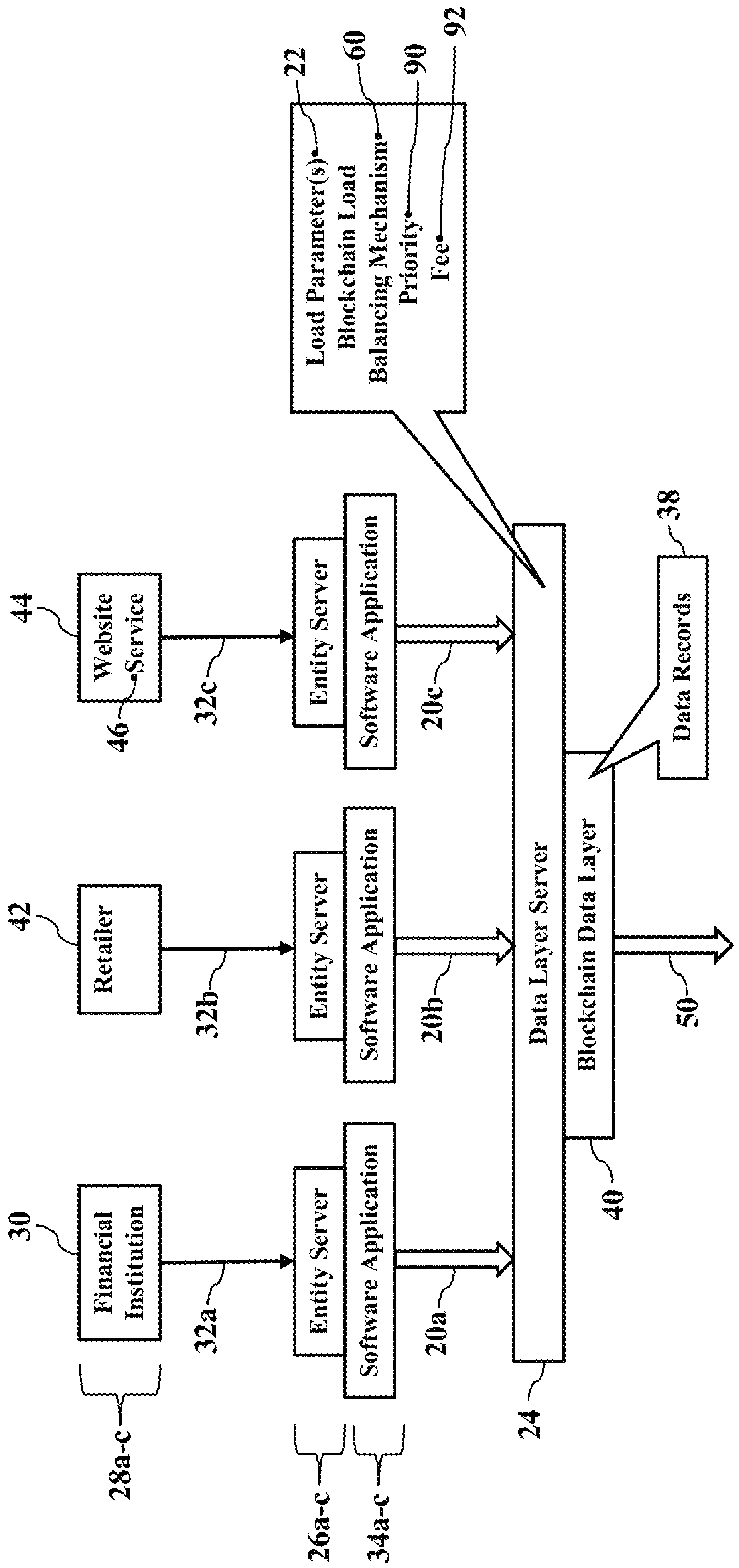
46
28a-c
32a
32b
32c
Entity Server
Software Application
Cryptocoinage
26a-c
34a-c
70a-c
20a
20b
20c
74a
74b
74c
76a
76b
76c
Data Layer Server
VM #1
VM #2
VM #3
VM #4
24
80a-d
Blockchain Data Layer
40
50
Data Records
38
Load Parameter(s)
Blockchain Load Balancing Mechanism
VM Share
Processing Ratio
22
60
82
84

FIG. 4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Financial Institution
42
Retailer
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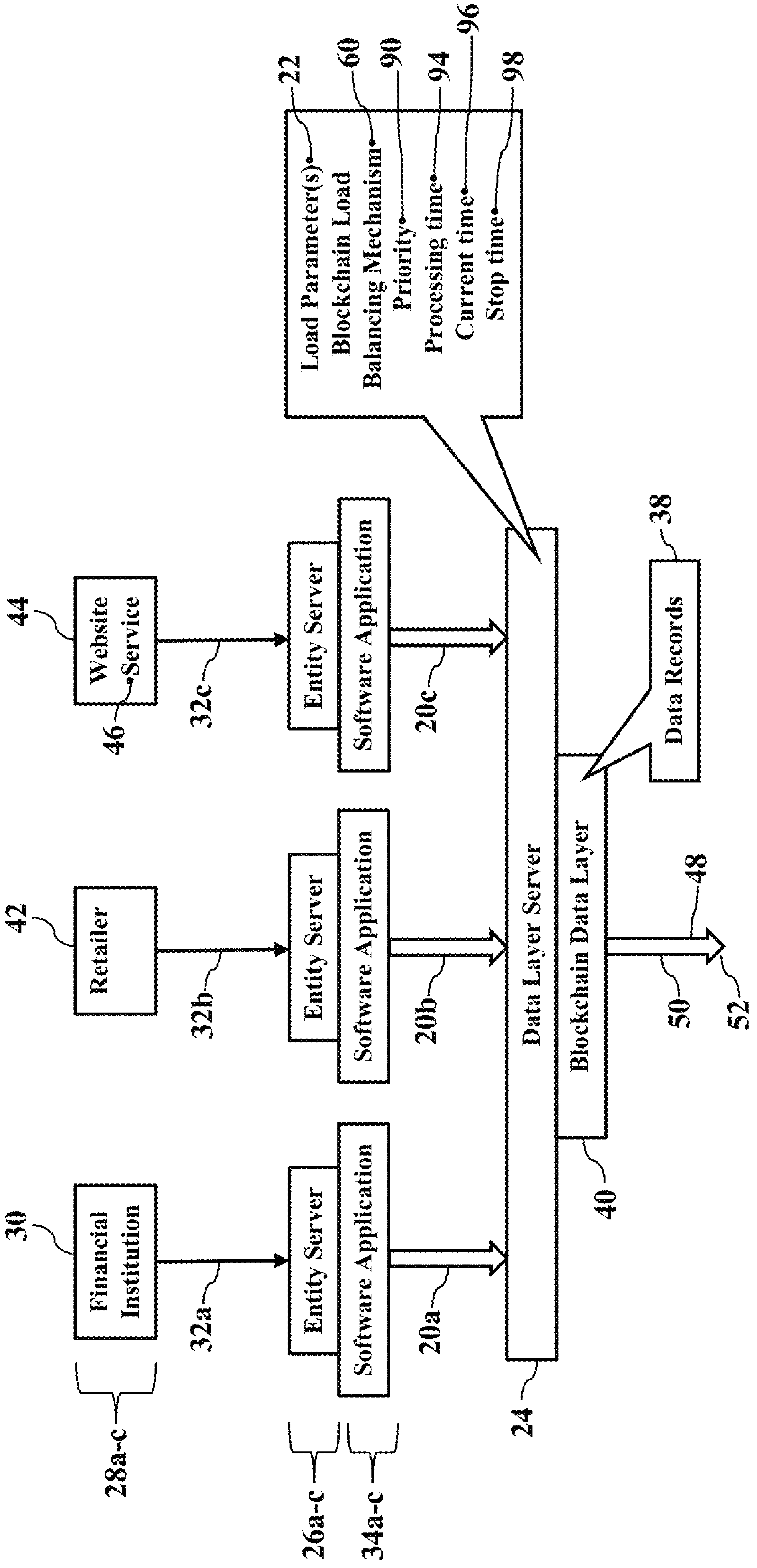
Website Service
46
32a
32b
32c
26a-c
34a-c
Entity Server
Software Application
Entity Server
Software Application
Entity Server
Software Application
20a
20b
20c
24
Data Layer Server
Blockchain Data Layer
40
50
Data Records
38
Load Parameter(s)
Blockchain Load Balancing Mechanism
Priority
Fee
22
60
90
92

FIG. 5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Software Application
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44
Website Service
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32c
Entity Server
Software Application
20c
24
Data Layer Server
40
Blockchain Data Layer
48
50
52
38
Data Records
22
60
90
94
96
98
Load Parameter(s)
Blockchain Load Balancing Mechanism
Priority
Processing time
Current time
Stop time

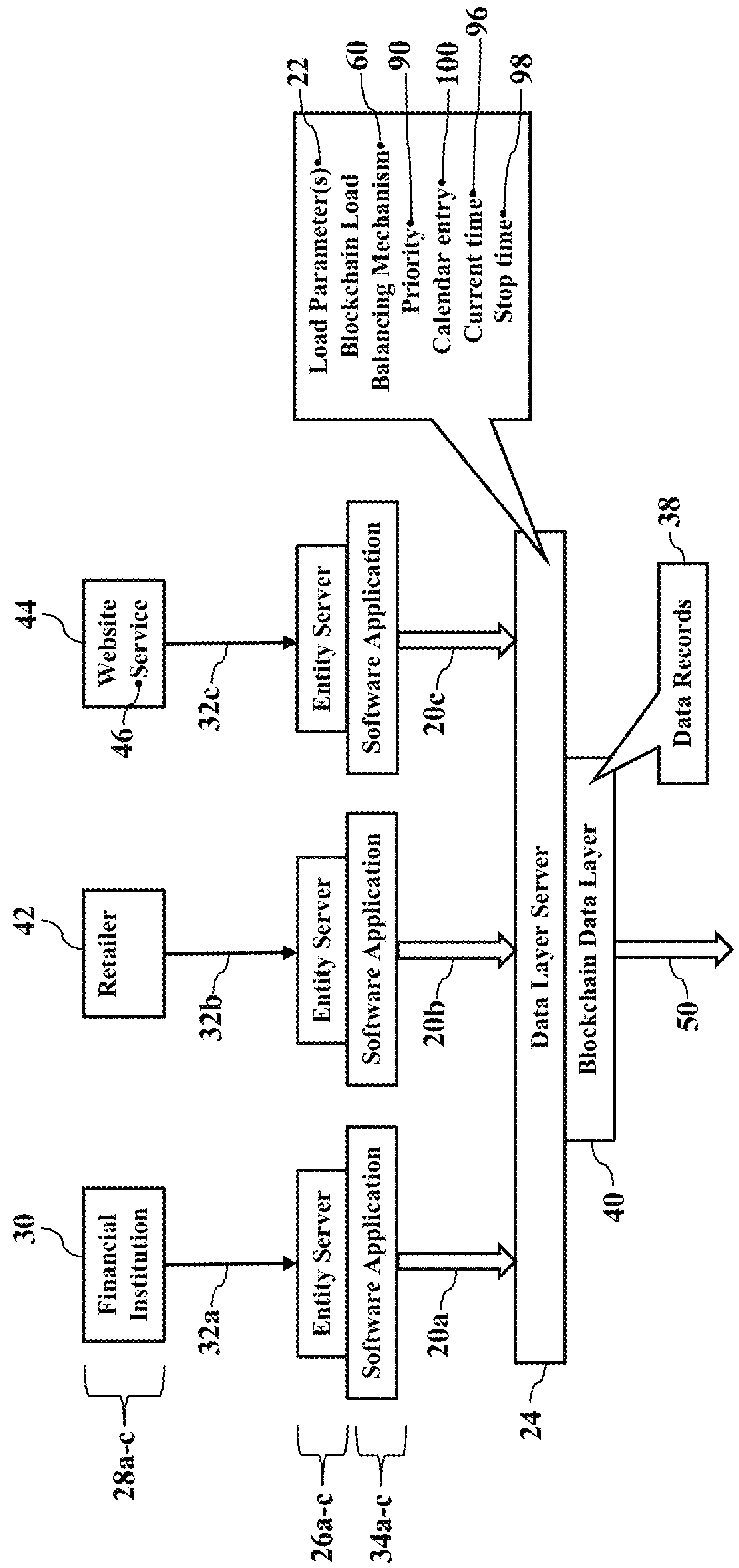

Load Parameter(s)
22
Blockchain Load Balancing Mechanism
60
Priority
90
Calendar entry
100
Current time
96
Stop time
98
Financial Institution
30
Retailer
42
Website Service
44
46
28a-c
32a
32b
32c
Entity Server
Software Application
26a-c
34a-c
20a
20b
20c
Data Layer Server
24
Blockchain Data Layer
40
Data Records
38
50

FIG. 6

FIG. 7

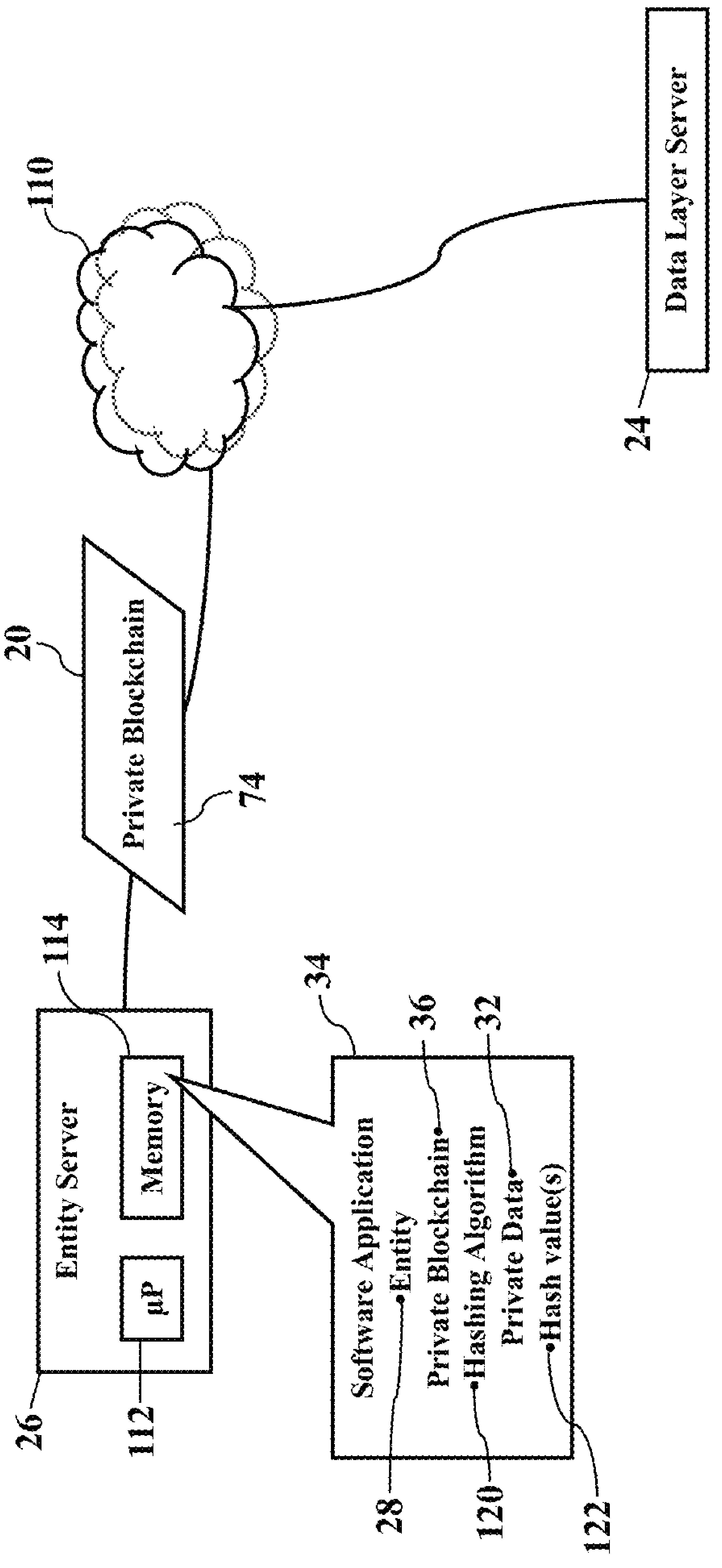

110
Data Layer Server
24
20
Private Blockchain
74
114
Entity Server
Memory
μP
26
112
34
36
32
Software Application
Entity
Private Blockchain
Hashing Algorithm
Private Data
Hash value(s)
28
120
122

FIG. 8

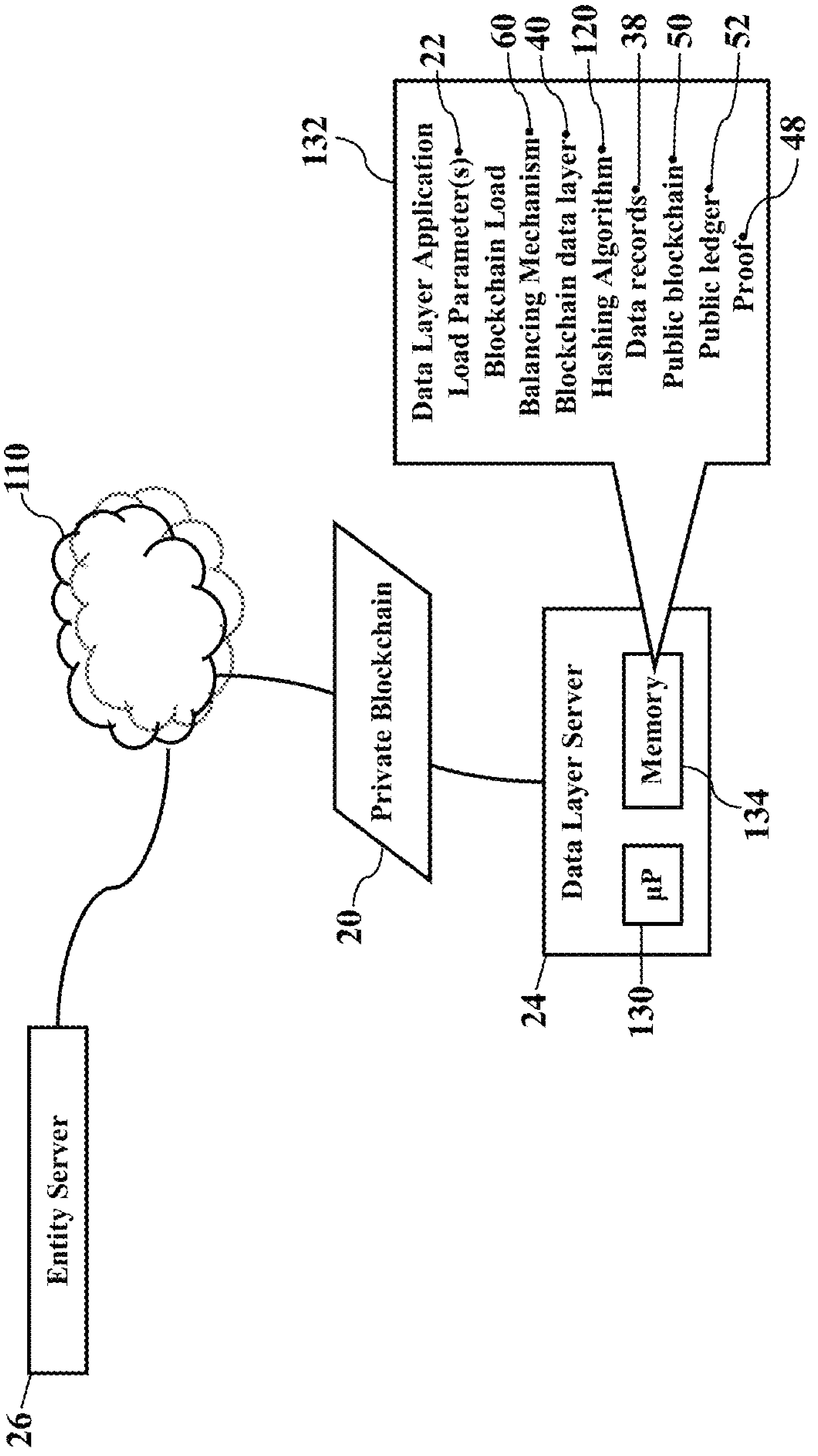

Entity Server
26
110
Private Blockchain
20
Data Layer Server
24
μP
130
Memory
134
132
Data Layer Application
Load Parameter(s)
22
Blockchain Load Balancing Mechanism
60
Blockchain data layer
40
Hashing Algorithm
120
Data records
38
Public blockchain
50
Public ledger
52
Proof
48

FIG. 9

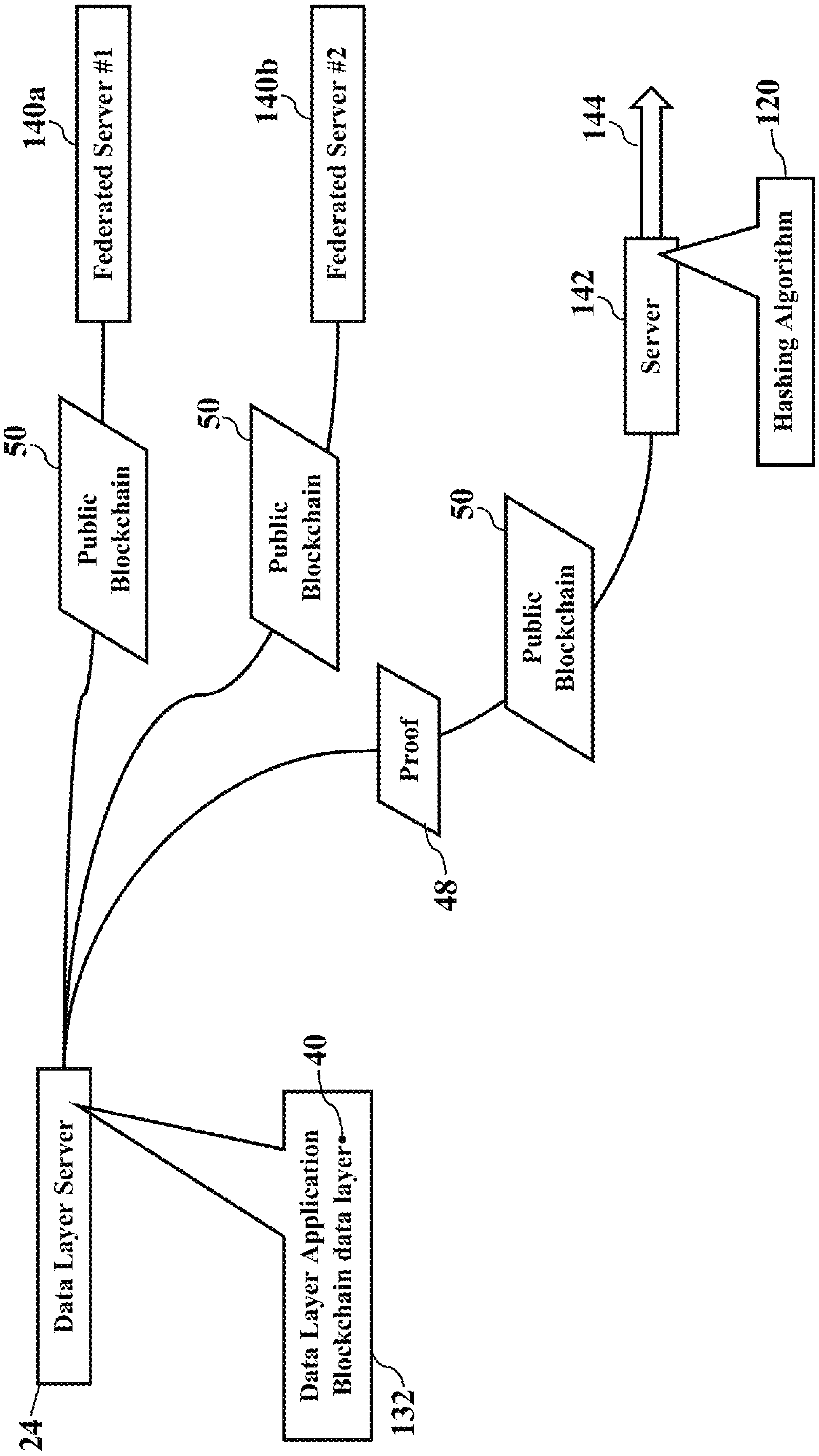

Federated Server #1
140a
Federated Server #2
140b
Public Blockchain
50
Public Blockchain
50
Public Blockchain
50
Server
142
144
Hashing Algorithm
120
Proof
48
Data Layer Server
24
Data Layer Application
Blockchain data layer
40
132

FIG. 10

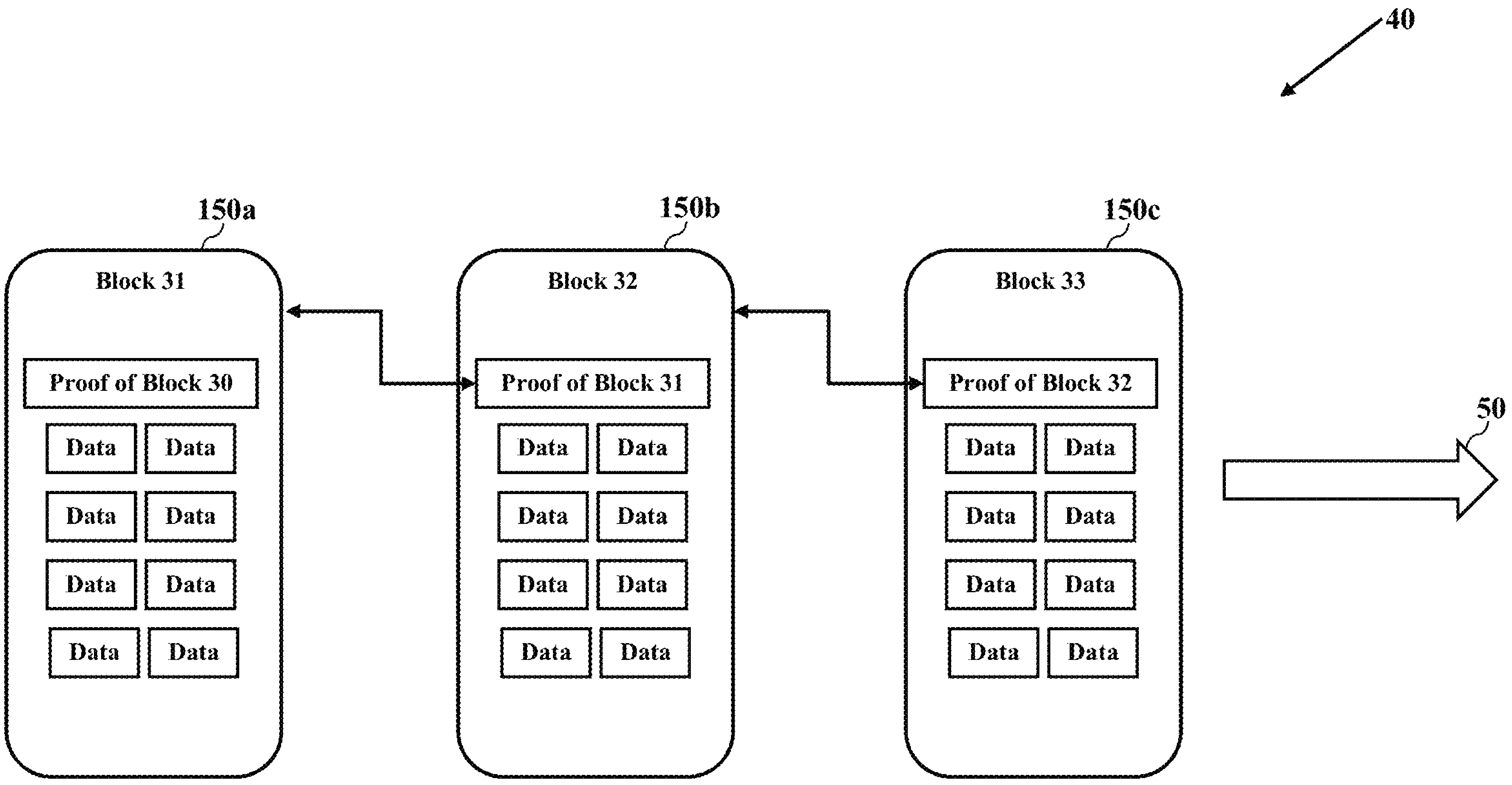

40
150a
150b
150c
Block 31
Block 32
Block 33
Proof of Block 30
Proof of Block 31
Proof of Block 32
Data
50

FIG. 11

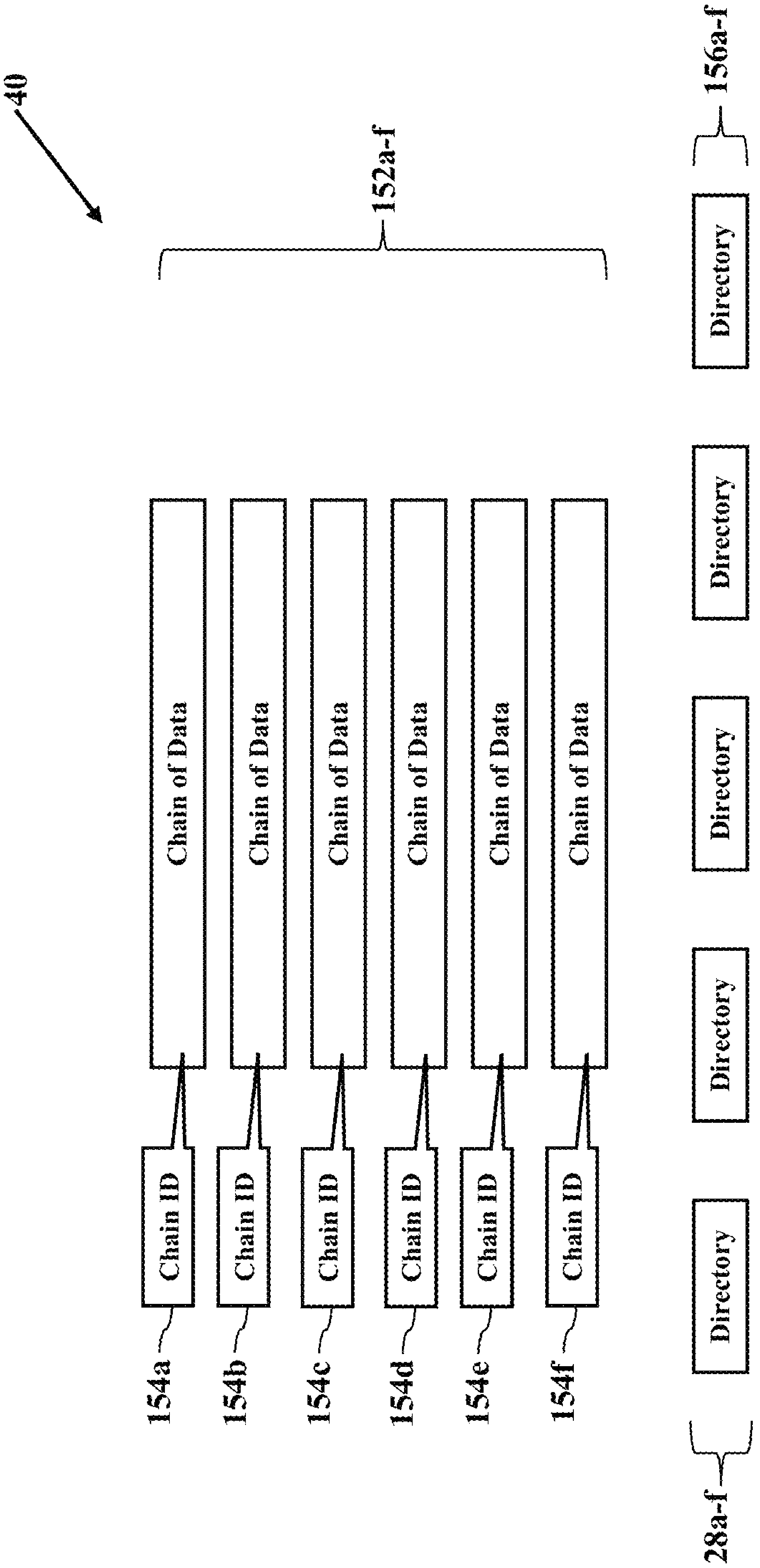
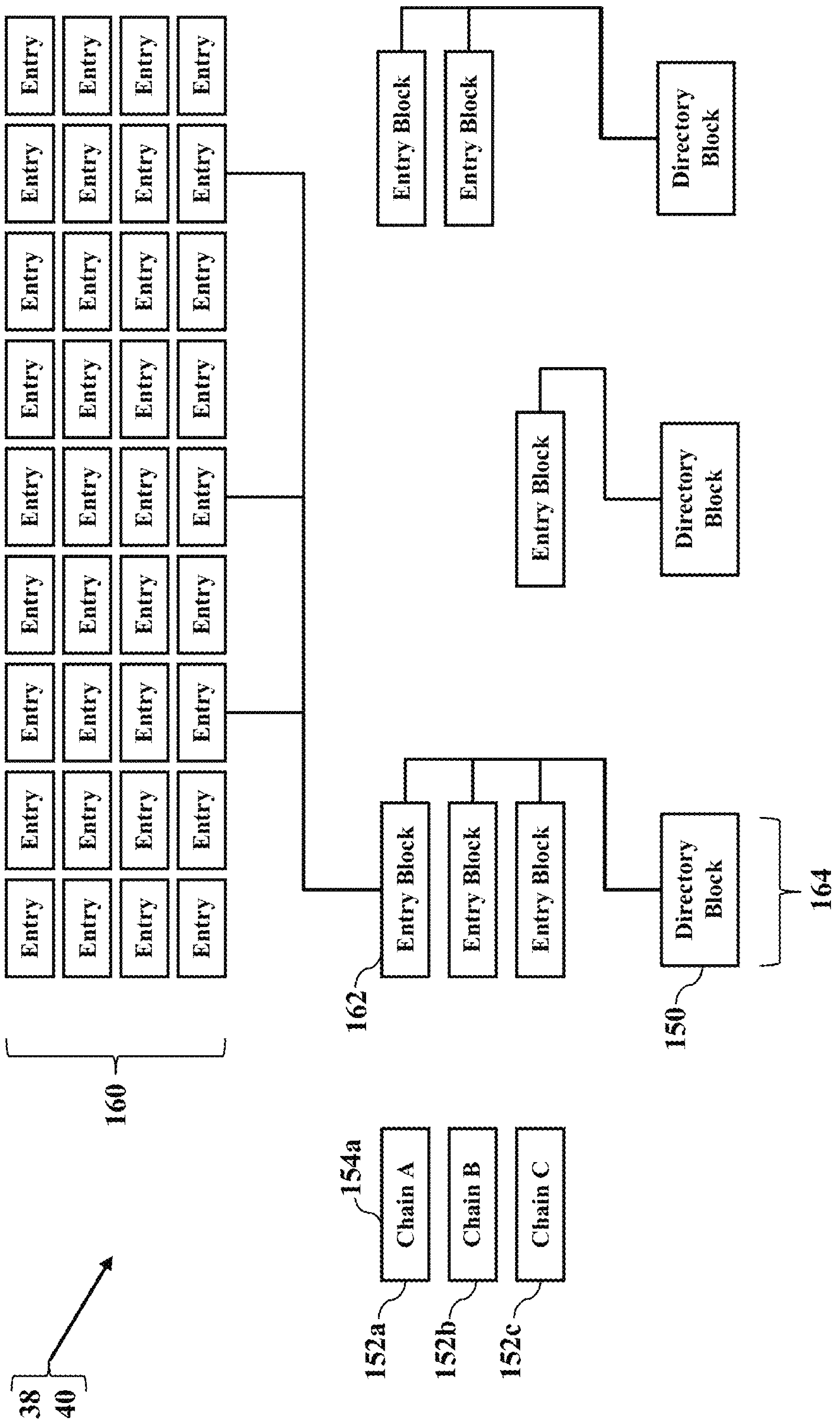

40
152a-f
156a-f
Chain of Data
Chain of Data
Chain of Data
Chain of Data
Chain of Data
Chain of Data
Chain ID
Chain ID
Chain ID
Chain ID
Chain ID
Chain ID
154a
154b
154c
154d
154e
154f
Directory
Directory
Directory
Directory
Directory
28a-f

FIG. 12


38
40
160
Entry
Entry Block
Directory Block
162
150
164
Chain A
Chain B
Chain C
154a
152a
152b
152c

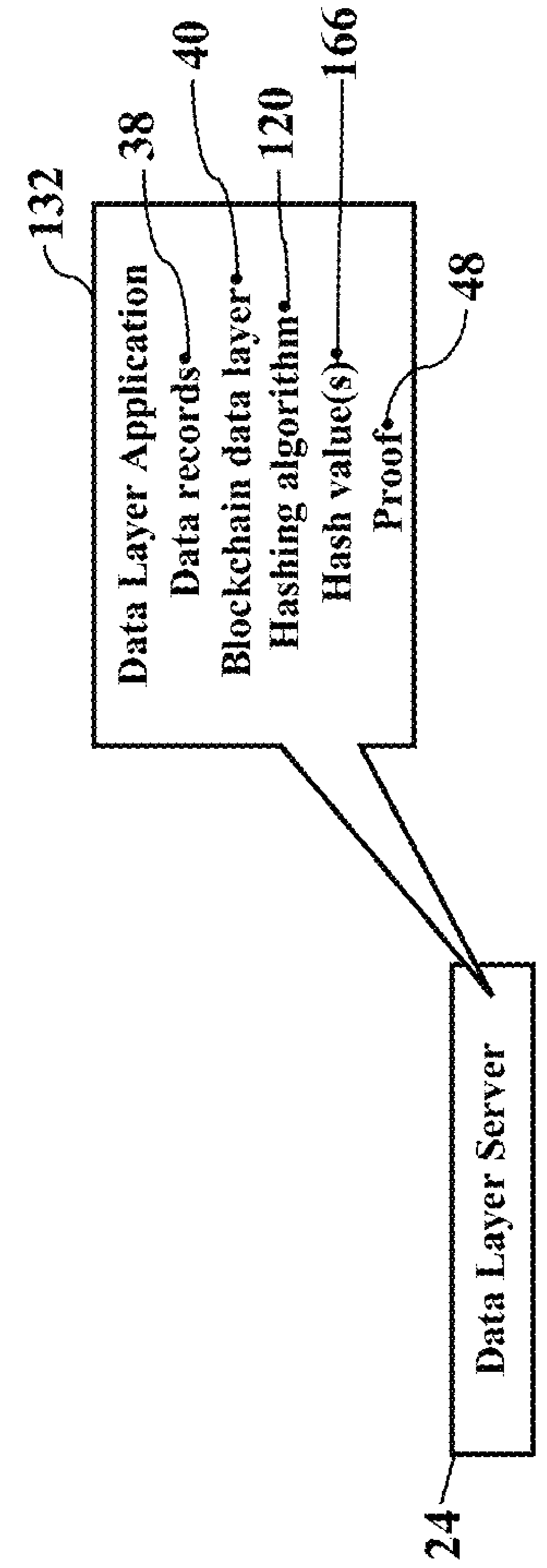

132
Data Layer Application
Data records
38
Blockchain data layer
40
Hashing algorithm
120
Hash value(s)
166
Proof
48
Data Layer Server
24

FIG. 13

FIG. 14

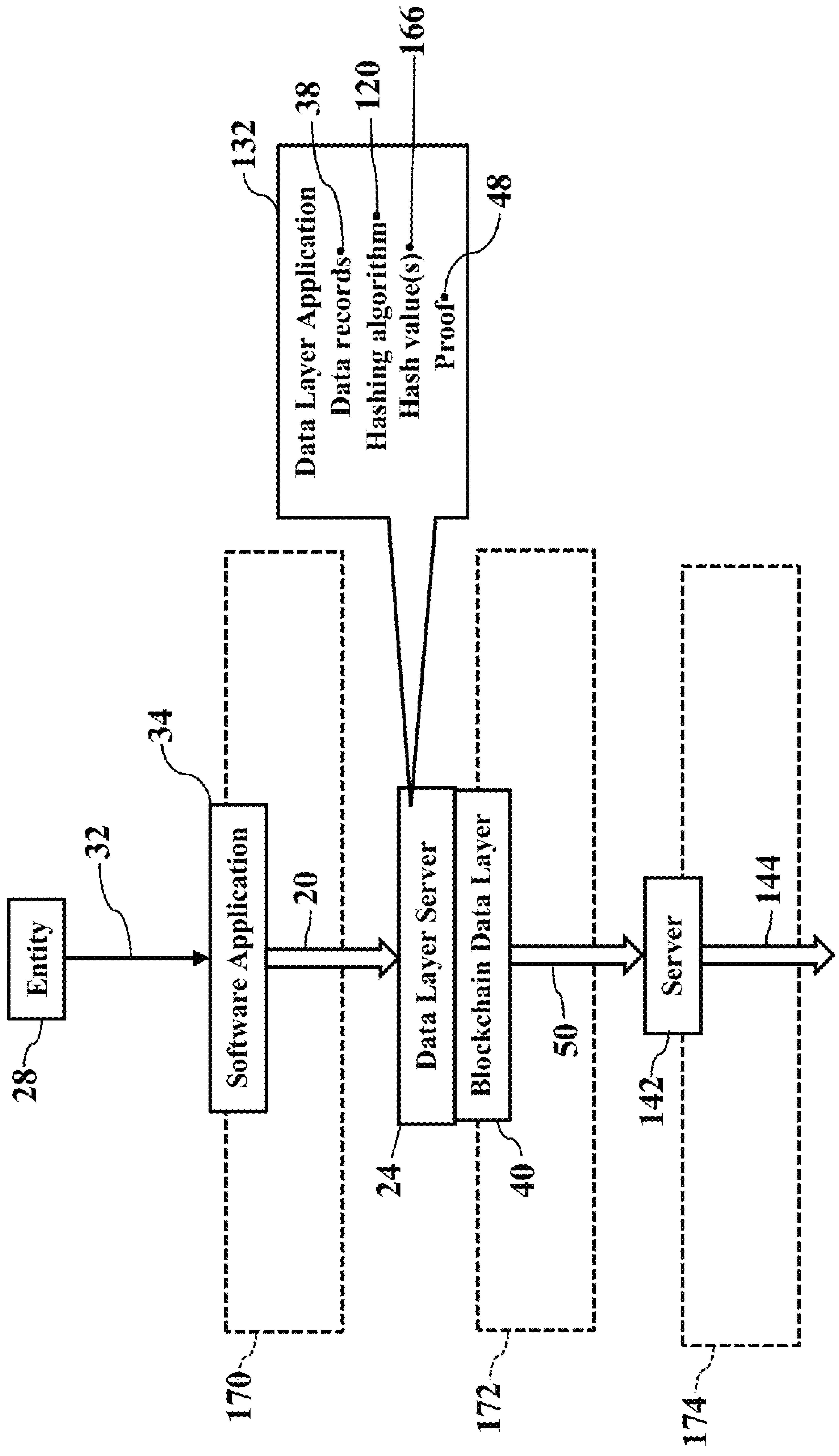

Entity
28
32
Software Application
34
20
Data Layer Server
24
Blockchain Data Layer
40
50
Server
142
144
170
172
174
Data Layer Application
132
Data records
38
Hashing algorithm
120
Hash value(s)
166
Proof
48

FIG. 15

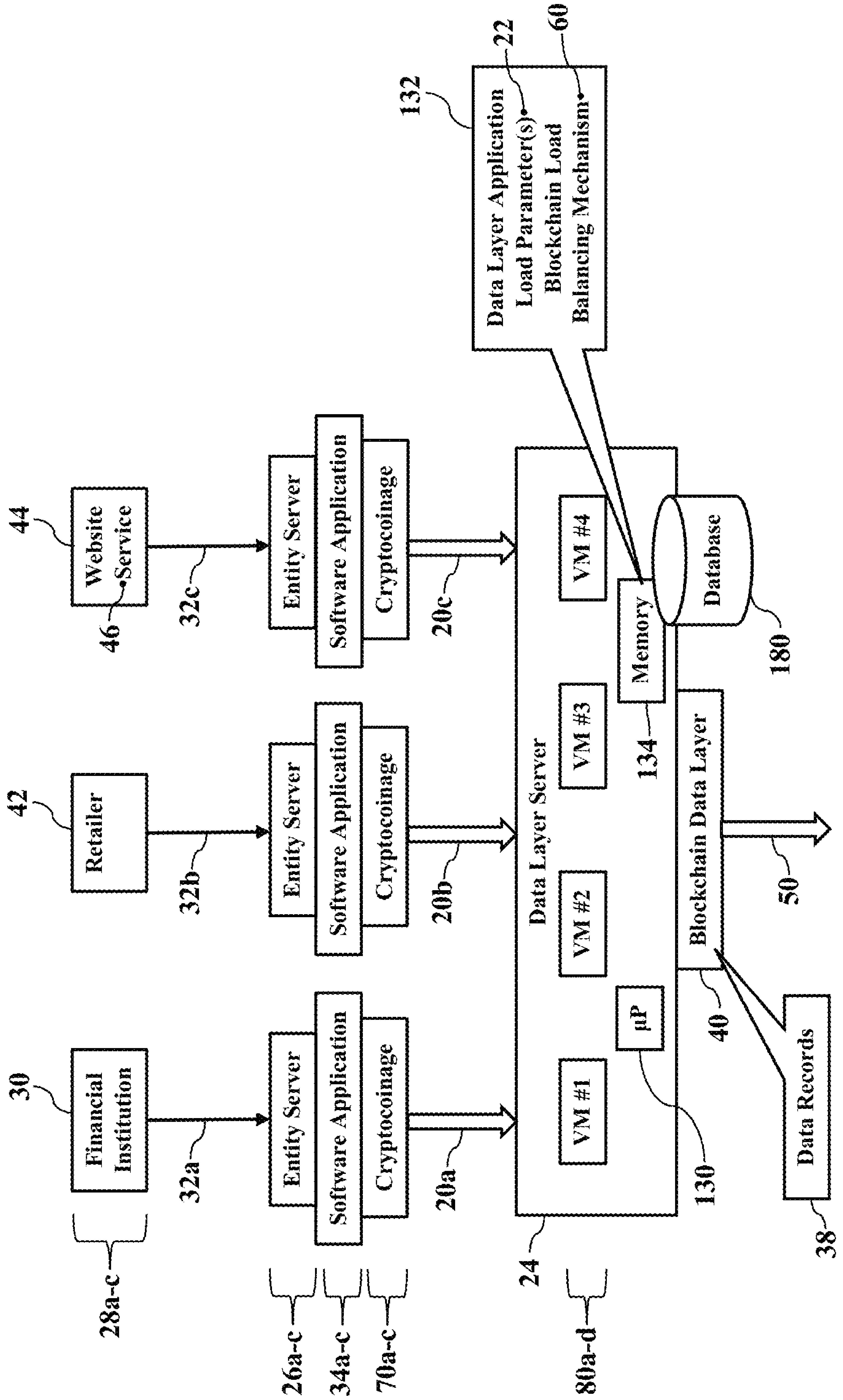

Financial Institution
30
28a-c
32a
Retailer
42
32b
Website Service
44
46
32c
Entity Server
Software Application
Cryptocoinage
26a-c
34a-c
70a-c
20a
20b
20c
Data Layer Server
24
VM #1
VM #2
VM #3
VM #4
80a-d
μP
130
Memory
134
Database
180
Blockchain Data Layer
40
50
Data Records
38
Data Layer Application
Load Parameter(s)
22
Blockchain Load Balancing Mechanism
60
132

FIG. 16

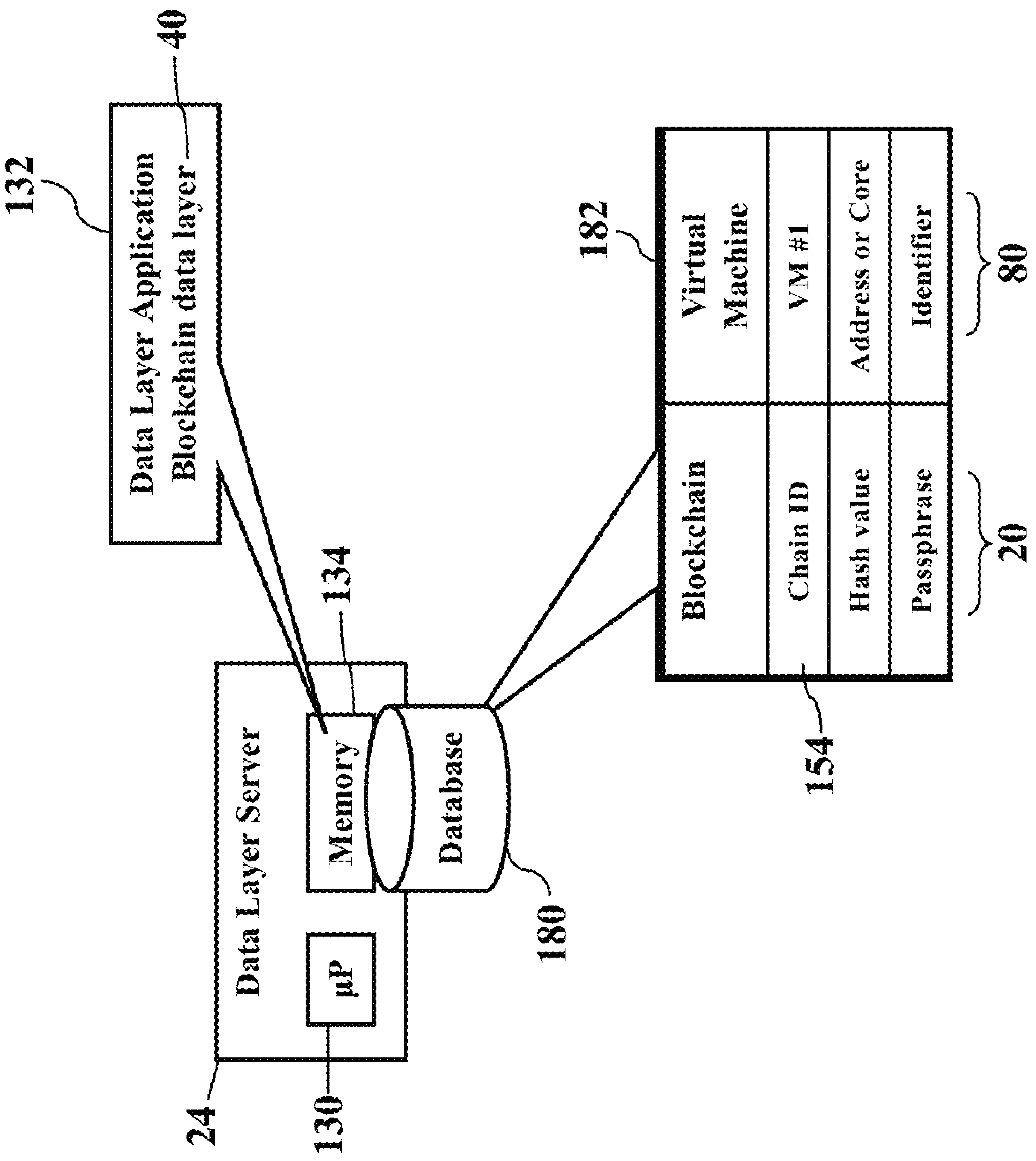
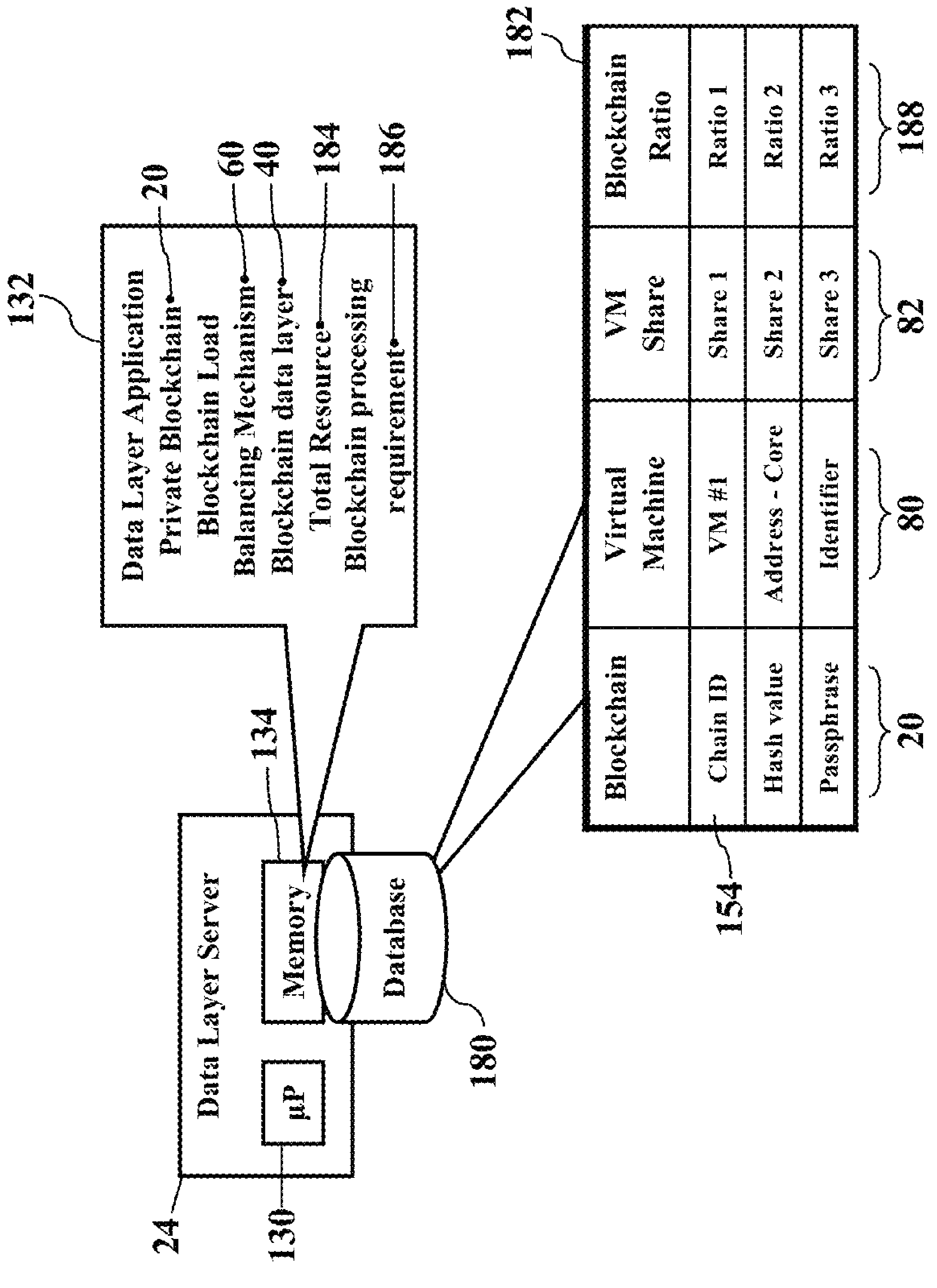
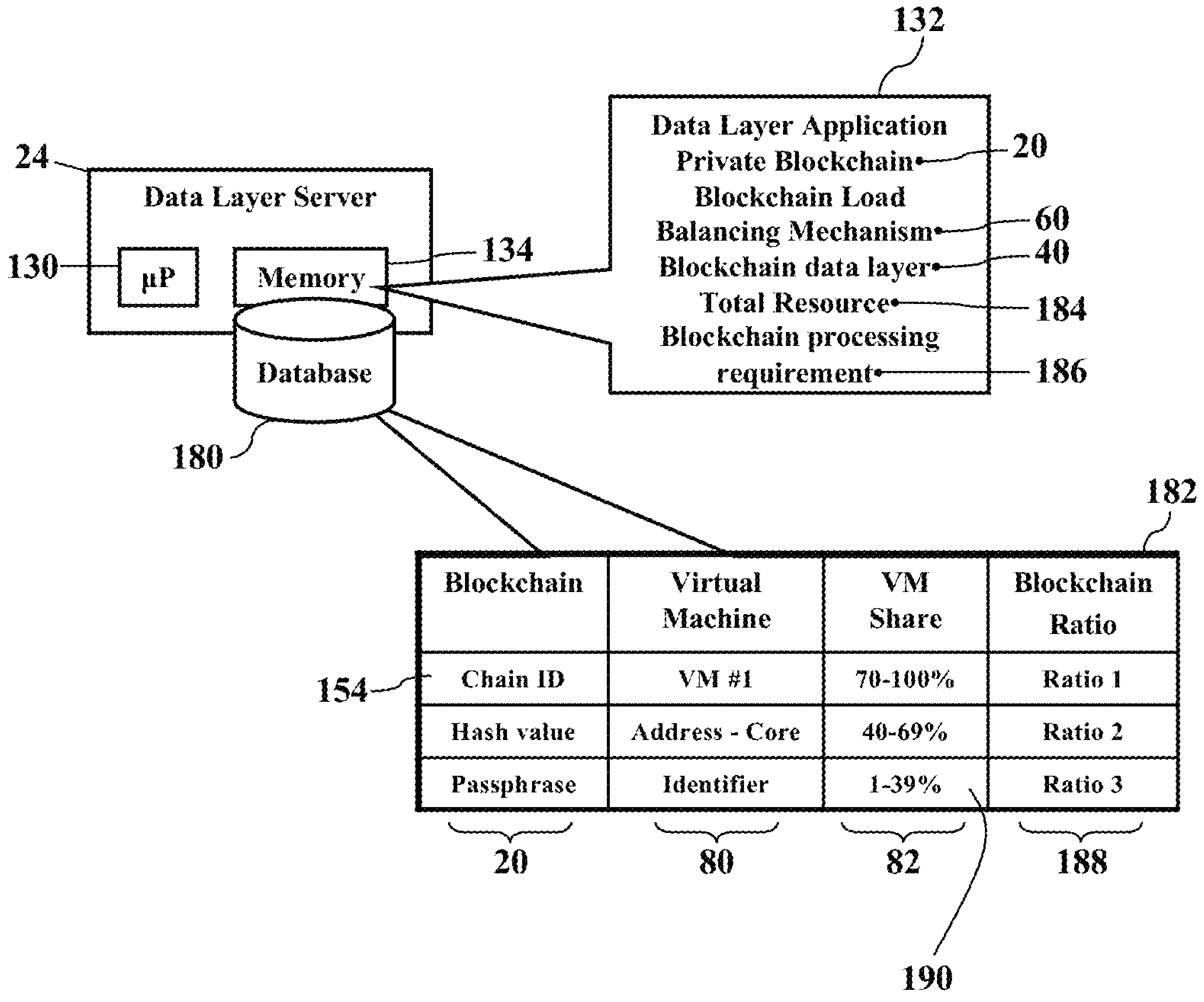

132
Data Layer Application
Blockchain data layer
40
24
Data Layer Server
130
μP
Memory
134
Database
180
182
Blockchain
Virtual Machine
Chain ID
VM #1
Hash value
Address or Core
Passphrase
Identifier
154
20
80

FIG. 17



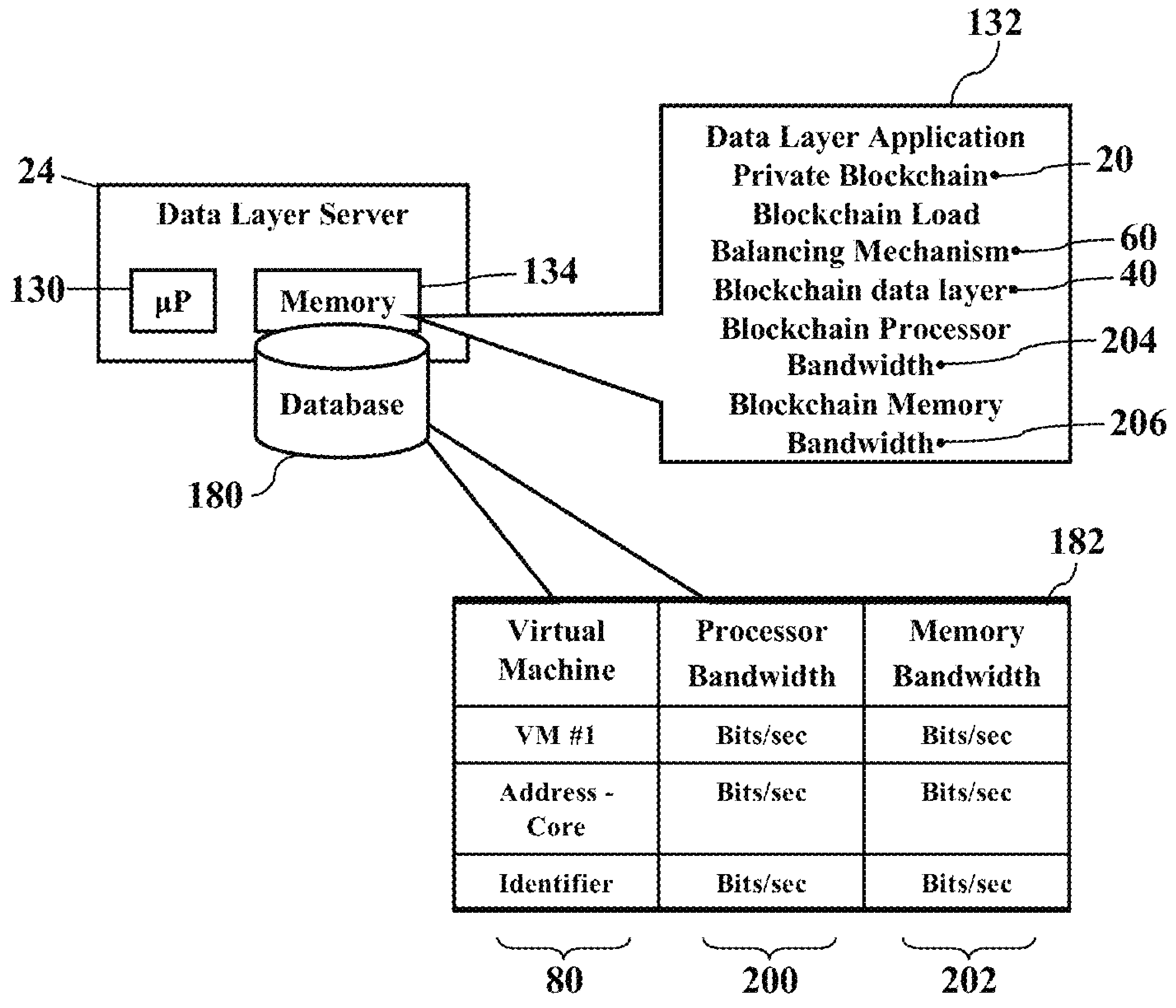
Blockchain	Virtual Machine	VM Share	Blockchain Ratio
Chain ID	VM #1	Share 1	Ratio 1
Hash value	Address - Core	Share 2	Ratio 2
Passphrase	Identifier	Share 3	Ratio 3

FIG. 18



Blockchain	Virtual Machine	VM Share	Blockchain Ratio
Chain ID	VM #1	70-100%	Ratio 1
Hash value	Address - Core	40-69%	Ratio 2
Passphrase	Identifier	1-39%	Ratio 3

FIG. 19



Virtual Machine	Processor Bandwidth	Memory Bandwidth
VM #1	Bits/sec	Bits/sec
Address - Core	Bits/sec	Bits/sec
Identifier	Bits/sec	Bits/sec

FIG. 20

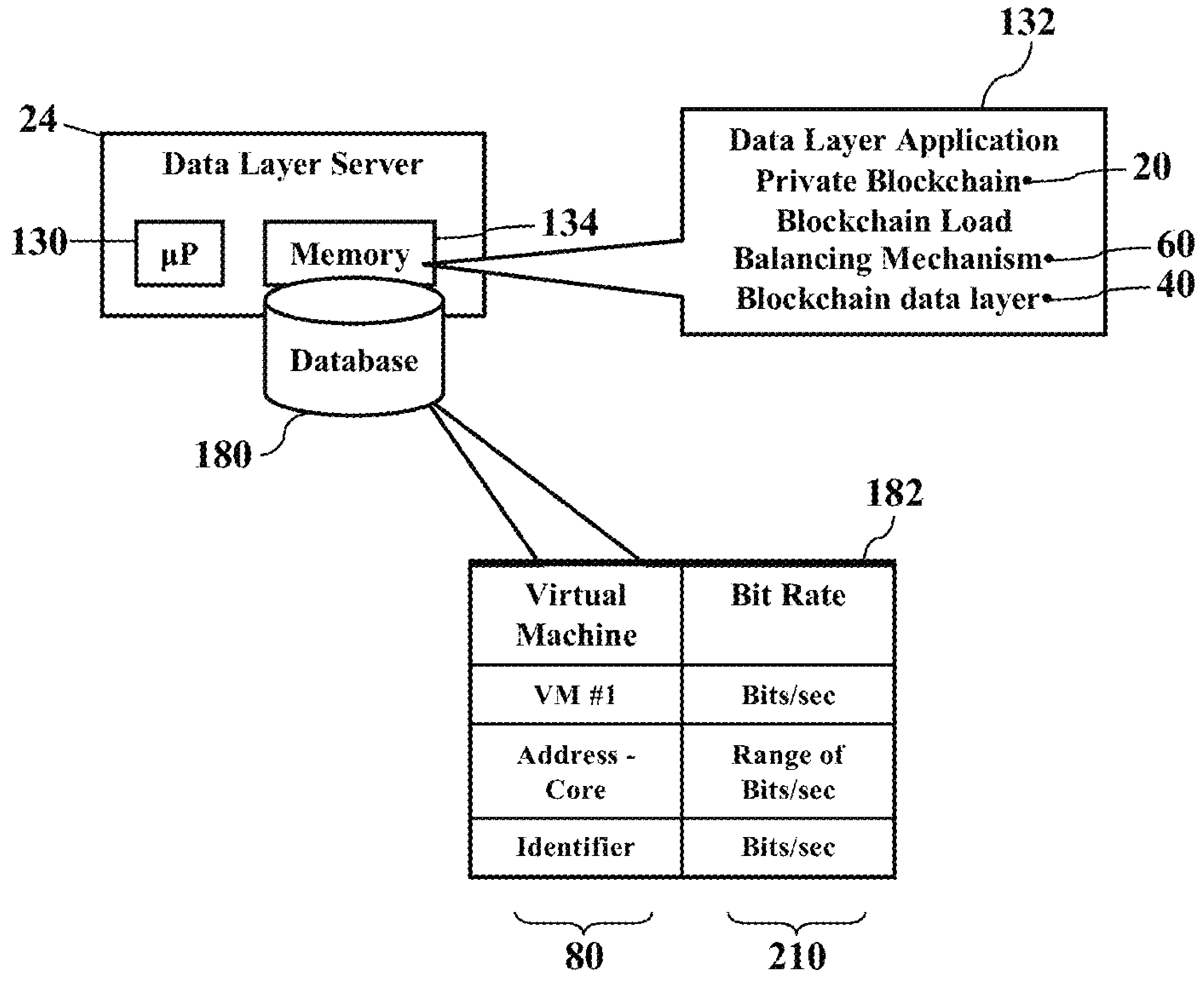
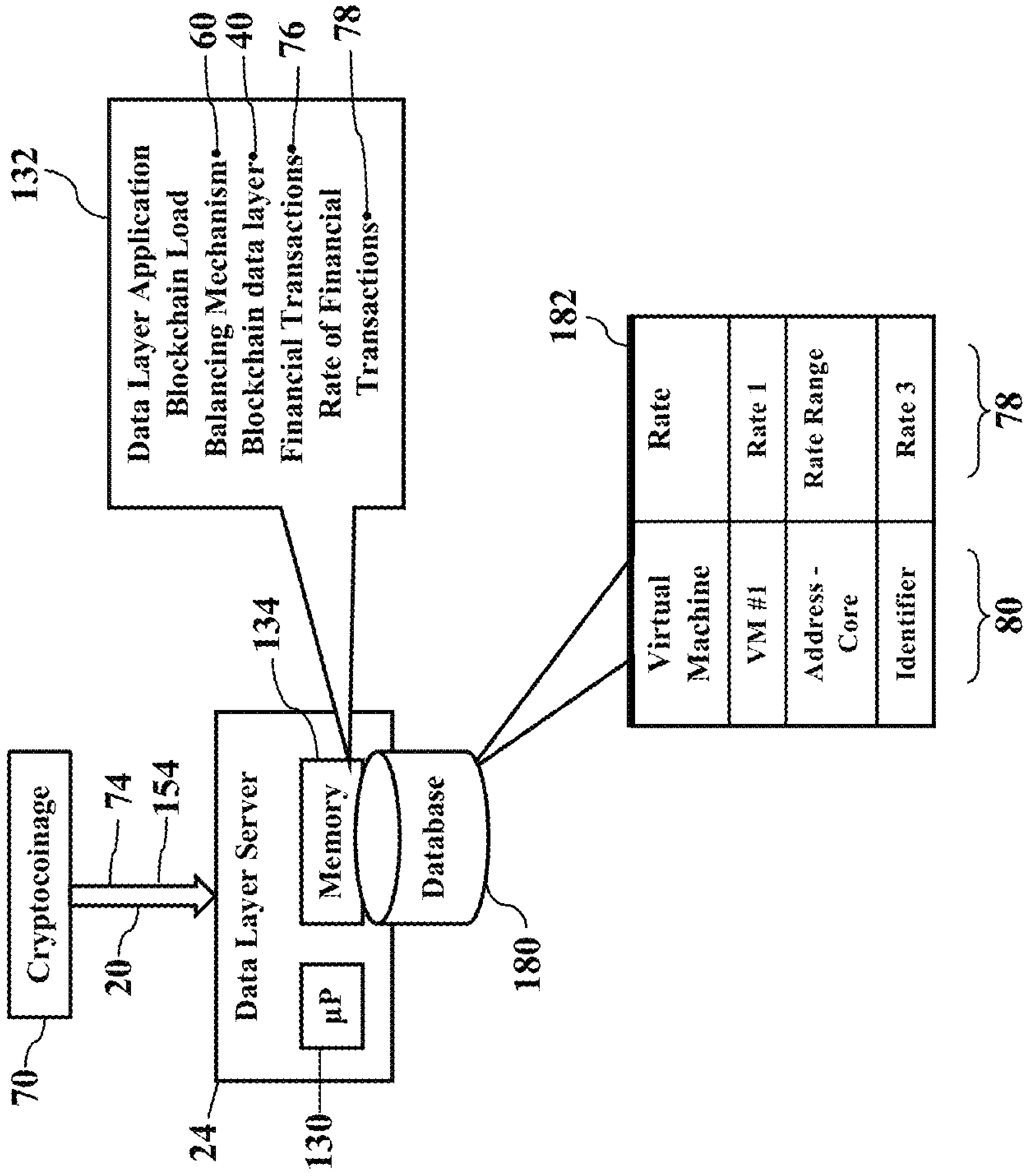

24
Data Layer Server
130
µP
Memory
134
Database
180
132
Data Layer Application
Private Blockchain
20
Blockchain Load
Balancing Mechanism
60
Blockchain data layer
40
182
Virtual Machine
Bit Rate
VM #1
Bits/sec
Address - Core
Range of Bits/sec
Identifier
Bits/sec
80
210

FIG. 21



Virtual Machine	Rate
VM #1	Rate 1
Address - Core	Rate Range
Identifier	Rate 3

FIG. 22

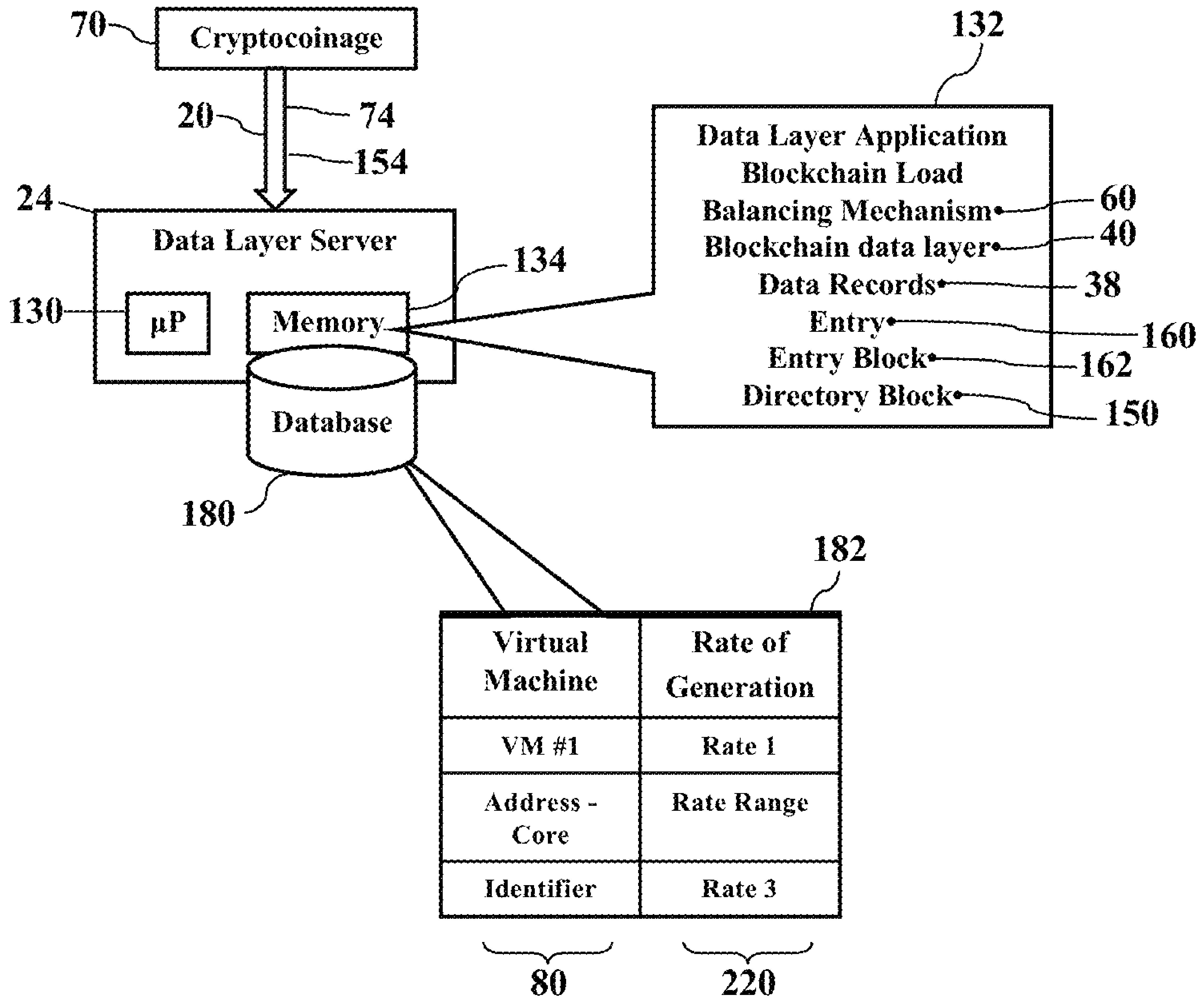
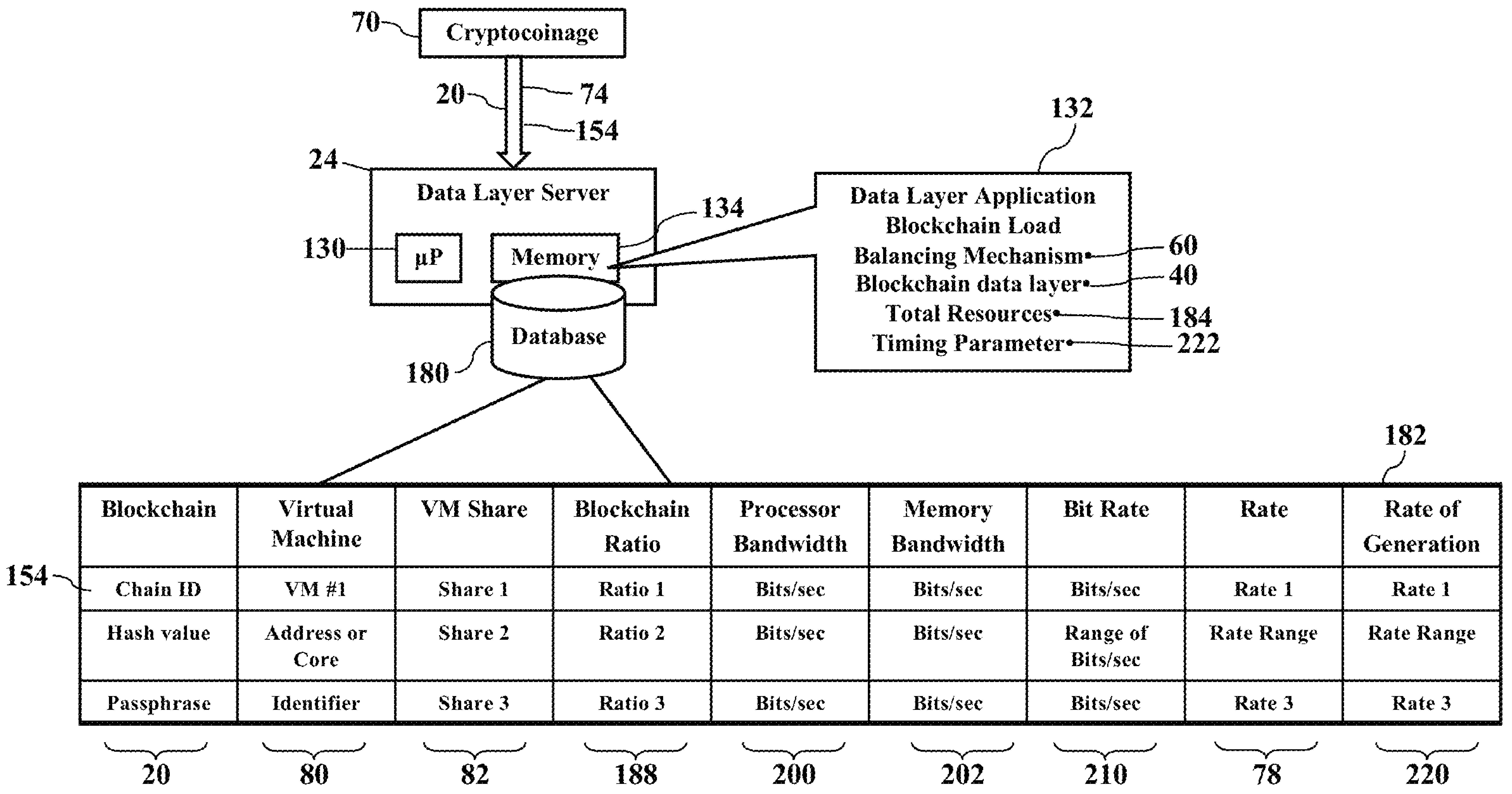

70
Cryptocoinage
20
74
154
24
Data Layer Server
130
µP
Memory
134
Database
180
132
Data Layer Application
Blockchain Load
Balancing Mechanism
60
Blockchain data layer
40
Data Records
38
Entry
160
Entry Block
162
Directory Block
150
182
Virtual Machine
Rate of Generation
VM #1
Rate 1
Address - Core
Rate Range
Identifier
Rate 3
80
220

FIG. 23



Blockchain	Virtual Machine	VM Share	Blockchain Ratio	Processor Bandwidth	Memory Bandwidth	Bit Rate	Rate	Rate of Generation
Chain ID	VM #1	Share 1	Ratio 1	Bits/sec	Bits/sec	Bits/sec	Rate 1	Rate 1
Hash value	Address or Core	Share 2	Ratio 2	Bits/sec	Bits/sec	Range of Bits/sec	Rate Range	Rate Range
Passphrase	Identifier	Share 3	Ratio 3	Bits/sec	Bits/sec	Bits/sec	Rate 3	Rate 3

FIG. 24

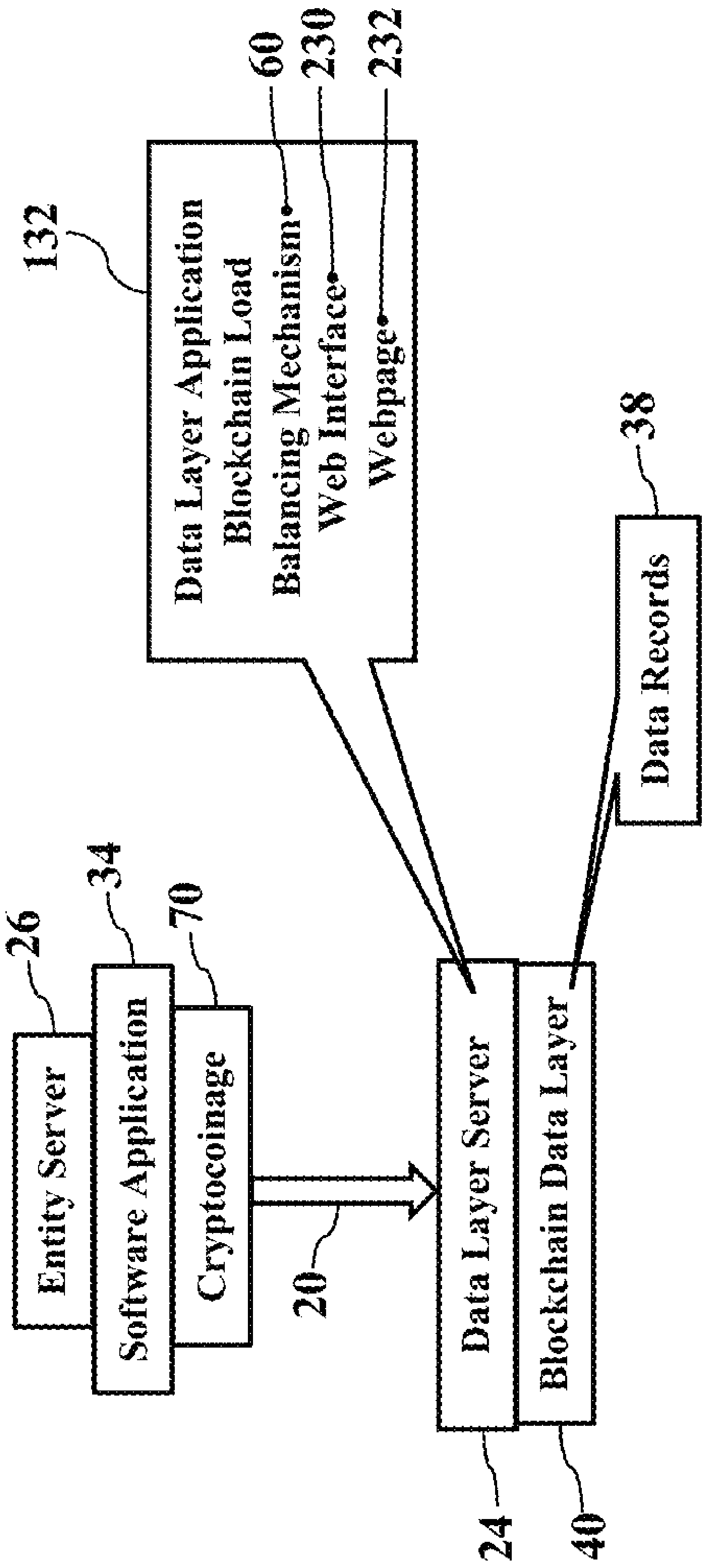

Entity Server
26
Software Application
34
Cryptocoinage
70
20
Data Layer Server
24
Blockchain Data Layer
40
Data Layer Application
Blockchain Load Balancing Mechanism
Web Interface
Webpage
132
60
230
232
Data Records
38

FIG. 25

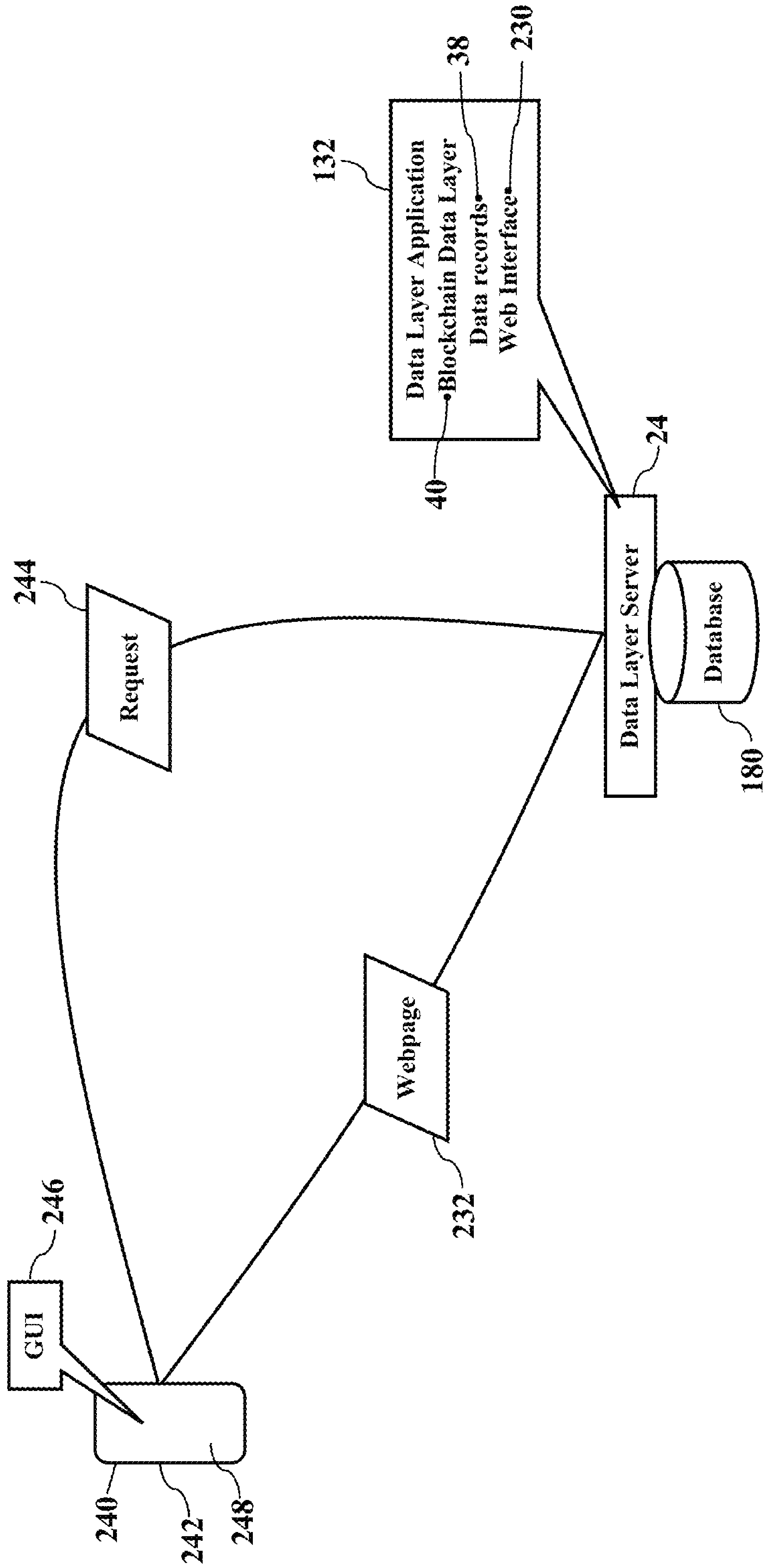

132
Data Layer Application
Blockchain Data Layer
Data records
Web Interface
40
38
230
24
Data Layer Server
Database
180
Request
244
Webpage
232
GUI
246
240
242
248

FIG. 26

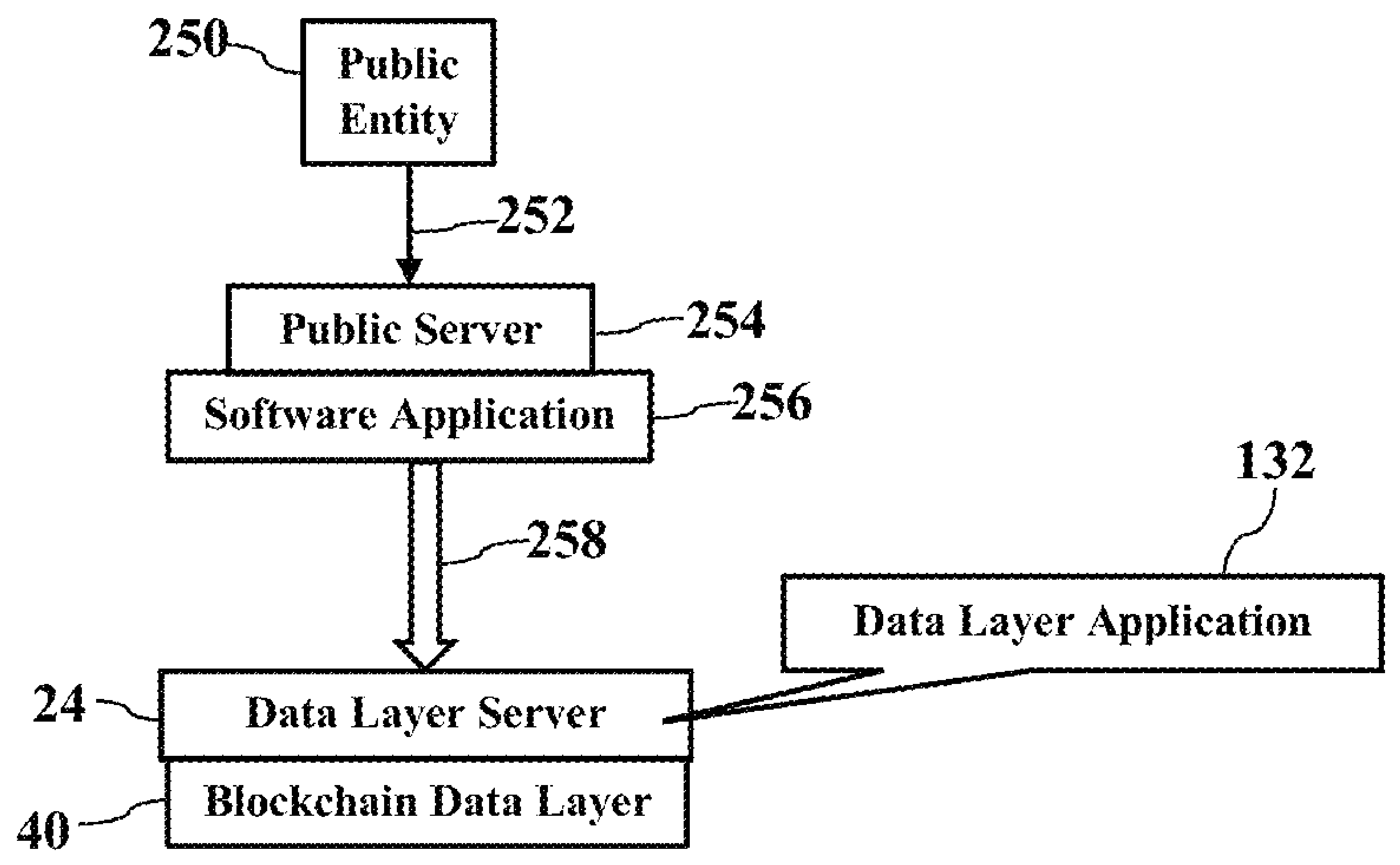

250
Public Entity
252
Public Server
254
Software Application
256
258
132
Data Layer Application
24
Data Layer Server
40
Blockchain Data Layer

FIG. 27

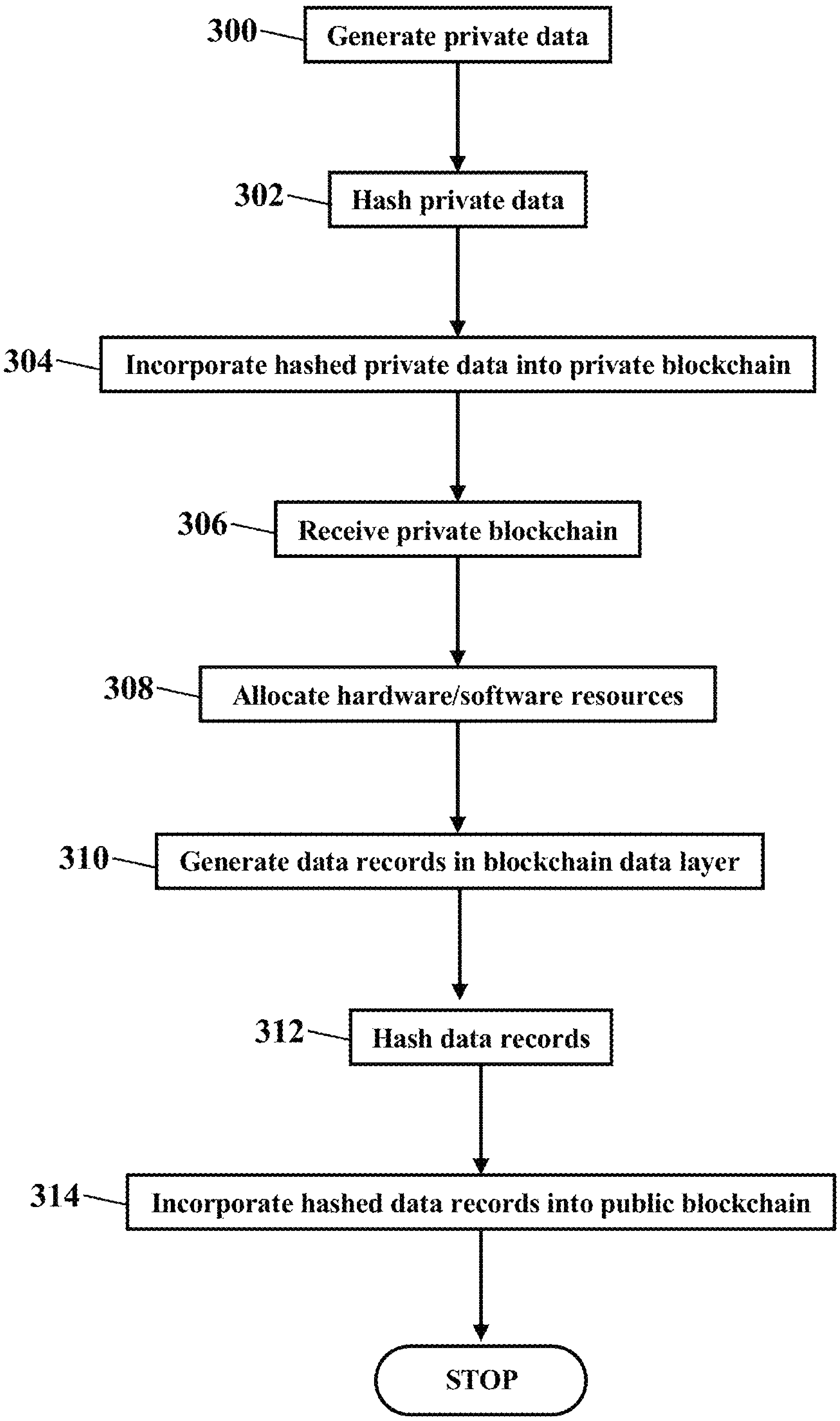

300
Generate private data
302
Hash private data
304
Incorporate hashed private data into private blockchain
306
Receive private blockchain
308
Allocate hardware/software resources
310
Generate data records in blockchain data layer
312
Hash data records
314
Incorporate hashed data records into public blockchain
STOP

FIG. 28

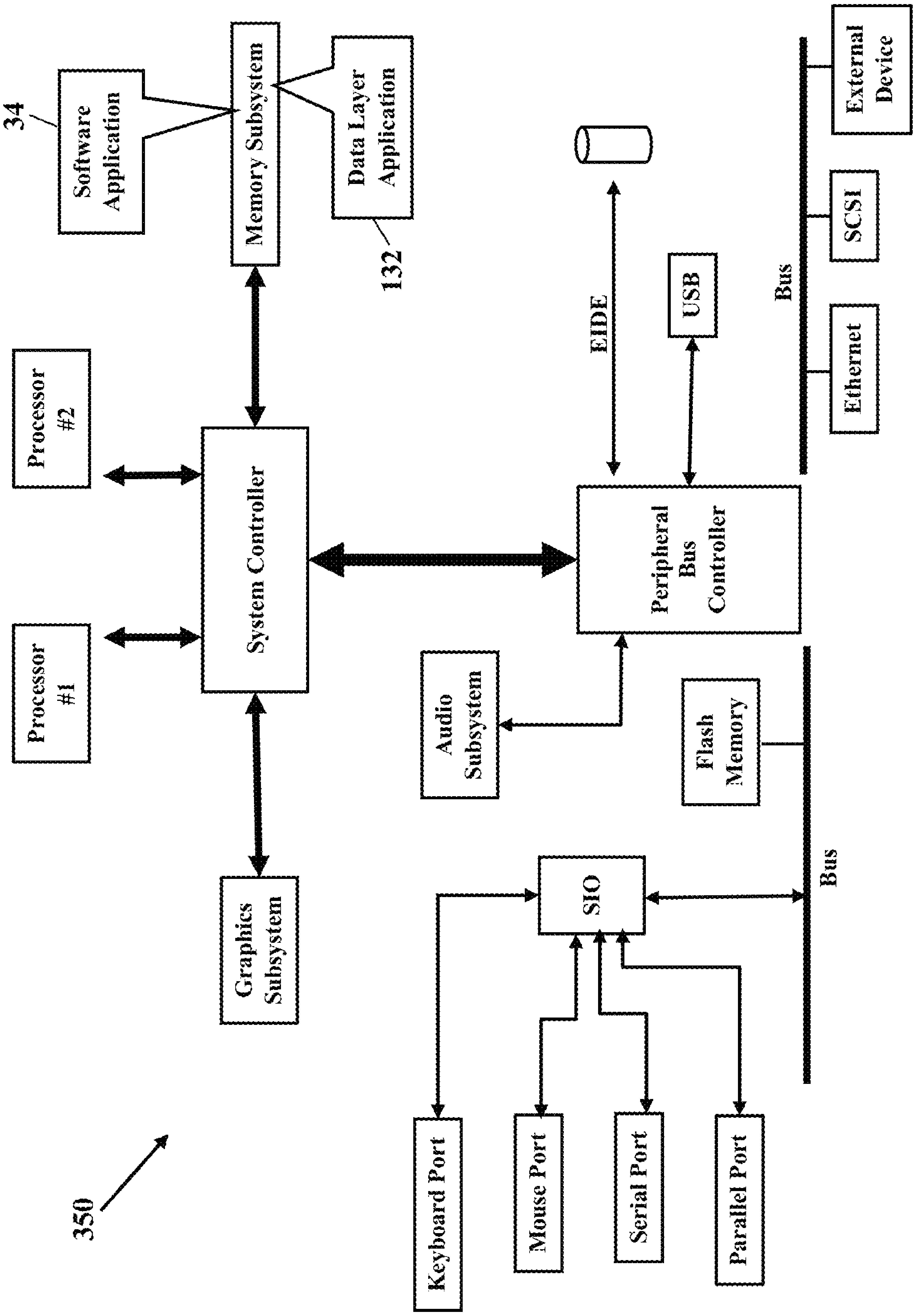
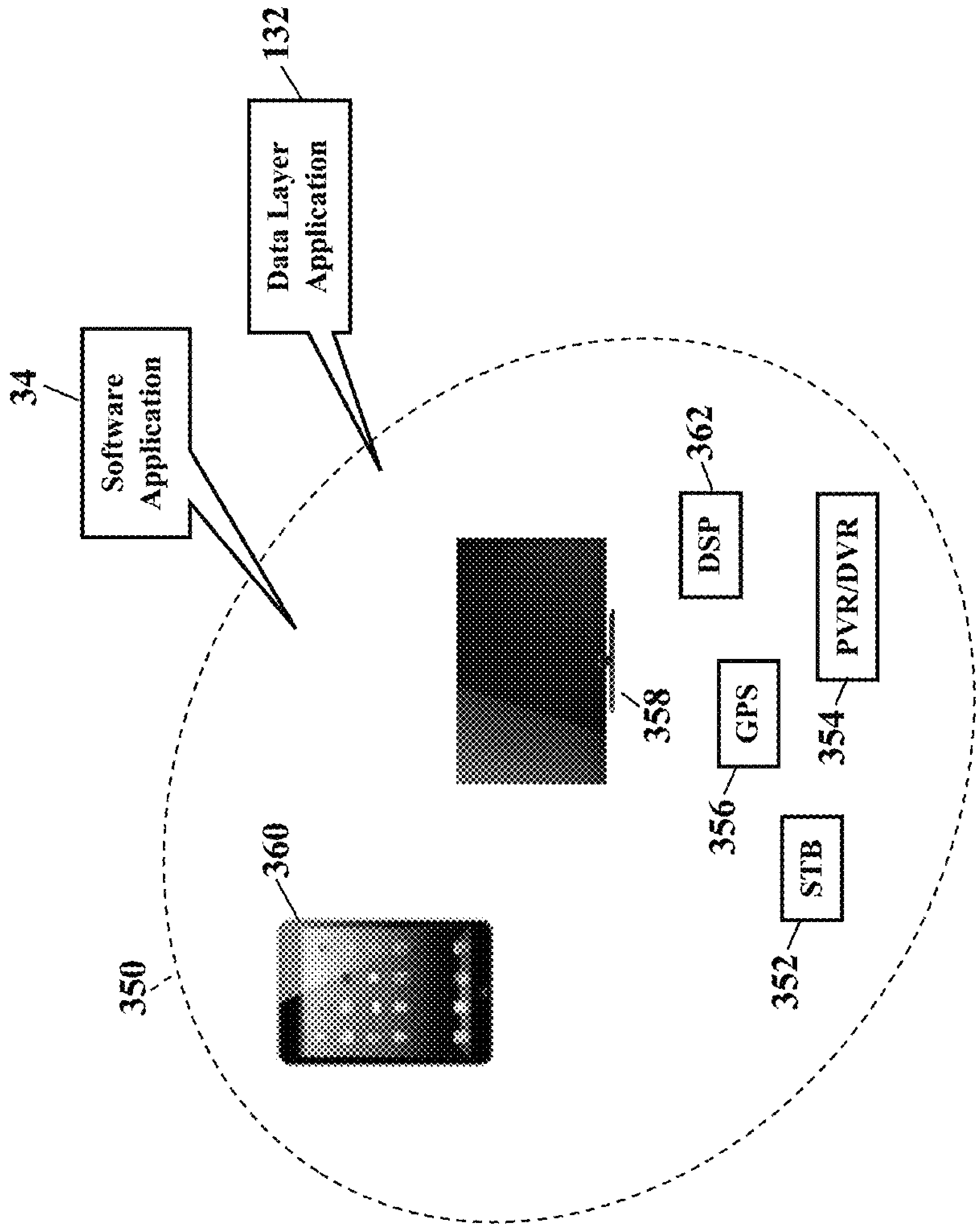

350
Processor #1
Processor #2
System Controller
Graphics Subsystem
Memory Subsystem
34
Software Application
Data Layer Application
132
Peripheral Bus Controller
Audio Subsystem
EIDE
USB
Bus
Ethernet
SCSI
External Device
Flash Memory
Bus
SIO
Keyboard Port
Mouse Port
Serial Port
Parallel Port

FIG. 29



132
Data Layer Application
34
Software Application
362
DSP
PVR/DVR
358
GPS
354
356
STB
352
360
350

LOAD BALANCING IN BLOCKCHAIN ENVIRONMENTS

CROSS-REFERENCE TO RELATED APPLICATIONS

This patent application is a continuation of U.S. application Ser. No. 15/983,595 filed May 18, 2018 and since issue as U.S. Patent X, which is incorporated herein by reference in its entirety. This patent application relates to U.S. application Ser. No. 15/983,572 filed May 18, 2018 and incorporated herein by reference in its entirety. This patent application also relates to U.S. application Ser. No. 15/983,612 filed May 18, 2018 and incorporated herein by reference in its entirety. This patent application also relates to U.S. application Ser. No. 15/983,632 filed May 18, 2018 and incorporated herein by reference in its entirety. This patent application also relates to U.S. application Ser. No. 15/983,655 filed May 18, 2018 and incorporated herein by reference in its entirety.

BACKGROUND

Decentralized cryptographic coinage is growing. As cryptographic coinage continues to gain acceptance, many entities will want to offer their own cryptographic coinage.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

The features, aspects, and advantages of the exemplary embodiments are understood when the following Detailed Description is read with reference to the accompanying drawings, wherein:

FIGS. **1**-**6** are simplified illustrations of load balancing of blockchains, according to exemplary embodiments;

FIGS. **7**-**9** are more detailed illustrations of an operating environment, according to exemplary embodiments;

FIGS. **10**-**14** further illustrate the blockchain data layer **40**, according to exemplary embodiments;

FIGS. **15**-**18** illustrate the virtual computing environment, according to exemplary embodiments;

FIGS. **19**-**20** illustrate bandwidths, according to exemplary embodiments;

FIG. **21** illustrates financial transactions per second, according to exemplary embodiments;

FIG. **22** illustrates allocations based on a blockchain data layer, according to exemplary embodiments;

FIG. **23** illustrates dynamic operation, according to exemplary embodiments;

FIGS. **24**-**25** illustrate web access, according to exemplary embodiments;

FIG. **26** illustrates a public entity, according to exemplary embodiments;

FIG. **27** is a flowchart illustrating a method or algorithm for load balancing of blockchains, according to exemplary embodiments; and

FIGS. **28**-**29** depict still more operating environments for additional aspects of the exemplary embodiments.

DETAILED DESCRIPTION

The exemplary embodiments will now be described more fully hereinafter with reference to the accompanying drawings. The exemplary embodiments may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. These

embodiments are provided so that this disclosure will be thorough and complete and will fully convey the exemplary embodiments to those of ordinary skill in the art. Moreover, all statements herein reciting embodiments, as well as specific examples thereof, are intended to encompass both structural and functional equivalents thereof. Additionally, it is intended that such equivalents include both currently known equivalents as well as equivalents developed in the future (i.e., any elements developed that perform the same function, regardless of structure).

Thus, for example, it will be appreciated by those of ordinary skill in the art that the diagrams, schematics, illustrations, and the like represent conceptual views or processes illustrating the exemplary embodiments. The functions of the various elements shown in the figures may be provided through the use of dedicated hardware as well as hardware capable of executing associated software. Those of ordinary skill in the art further understand that the exemplary hardware, software, processes, methods, and/or operating systems described herein are for illustrative purposes and, thus, are not intended to be limited to any particular named manufacturer.

As used herein, the singular forms "a," "an," and "the" are intended to include the plural forms as well, unless expressly stated otherwise. It will be further understood that the terms "includes," "comprises," "including," and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof. It will be understood that when an element is referred to as being "connected" or "coupled" to another element, it can be directly connected or coupled to the other element or intervening elements may be present. Furthermore, "connected" or "coupled" as used herein may include wirelessly connected or coupled. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items.

It will also be understood that, although the terms first, second, etc. may be used herein to describe various elements, these elements should not be limited by these terms. These terms are only used to distinguish one element from another. For example, a first device could be termed a second device, and, similarly, a second device could be termed a first device without departing from the teachings of the disclosure.

FIGS. **1**-**6** are simplified illustrations of load balancing of blockchains, according to exemplary embodiments. Exemplary embodiments allocate processing of multiple blockchains **20**, based on one or more load parameters **22**. FIG. **1**, for example, illustrates a data layer server **24** receiving the multiple blockchains **20**. In actual practice the data layer server **24** may receive several, tens, or even hundreds of different blockchains **20**. For simplicity, though, FIG. **1** only illustrates three (3) blockchains **20***a*-*c*. Each blockchain **20***a*-*c* may be sent from a corresponding entity server **26***a*-*c* that is operated on behalf of some entity **28***a*-*c*. While exemplary embodiments may be applied to any public or private entity, FIG. **1** illustrates entities **28***a*-*c* that are familiar to most readers. The entity server **26***a*, for example, is operated on behalf of a bank, lender, or other financial institution **30** (such as PIMCO®, CITI®, or BANK OF AMERICA®). As the reader likely understands, the financial institution **30** creates a massive amount of banking records, transaction records, mortgage instruments, and other private data **32***a*. The entity server **26***a* executes a software application **34***a* that encrypts its private data **32***a*. While the financial institution **30** may use any encryption scheme, FIG. **1** illustrates a private blockchain **20***a*. That is, the financial institution's entity server **26***a* cryptographically hashes its private data **32***a* into the private blockchain **20***a* and sends or feeds the private blockchain **20***a* to the data layer server **24**. The data layer server **24** then uses the private blockchain **20***a* to generate various data records **38** associated with a blockchain data layer **40**, as later paragraphs will explain.

The data layer server **24** may also receive the additional blockchains **20***b* and **20***c*. Blockchain **20***b*, for example, may be generated by the entity server **26***b* that is operated on behalf of the entity **28***b*. FIG. **1** illustrates the entity **28***b* as any retailer **42** (such as HOME DEPOT®, KOHL'S®, or WALMART®) that sends its private data **32***b* to the entity server **26***b*. The entity server **26***b* executes software application **34***b* to cryptographically hash the private data **32***b* into the private blockchain **20***b*. The entity server **26***b* sends or feeds the private blockchain **20***b* to the data layer server **24**. Similarly, entity **28***c* represents any website **44** offering an online service **46** (such as AMAZON®, NETFLIX®, or GOOGLE®). The entity server **26***c* executes the software application **34***c* to cryptographically hash the private data **32***c*, generate the private blockchain **20***c*, and send the private blockchain **20***c* to the data layer server **24**.

The data layer server **24** thus receives the multiple blockchains **20***a-c*. The data layer server **24** accepts the private blockchains **20***a-c* as inputs and generates the blockchain data layer **40**. The blockchain data layer **40** contains the various data records **38**, as later paragraphs will explain. Moreover, the blockchain data layer **40** may also add another layer of cryptographic hashing to generate one or more cryptographic proofs **48**. The cryptographic proofs **48** may then be incorporated into one or more public blockchains **50**. The blockchain data layer **40** may thus acts as a validation service **52** for the private blockchains **20***a-c*. The public blockchain **50** thus publishes the cryptographic proofs **48** as a public ledger **52** that establishes chains of blocks of immutable evidence. Each cryptographic proof **48** thus provides evidentiary documentation of the blocks of data contained within the respective private blockchains **20***a-c*.

Exemplary embodiments, though, may limit or allocate the data layer server **24** and/or the blockchain data layer **40**. That is, as the data layer server **24** receives the private blockchains **20***a-c* and generates the blockchain data layer **40**, exemplary embodiments may implement a blockchain load balancing mechanism **60**. The blockchain load balancing mechanism **60** analyzes any information or data (such as the one or more load parameters **22**) to determines how and/or when data layer server **24** processes the private blockchains **20***a-c* to generate the blockchain data layer **40**. The blockchain load balancing mechanism **60** thus determines how the multiple blockchains **20***a-c* share, consume, or monopolize the processing capabilities of the data layer server **24** and/or the blockchain data layer **40**.

FIG. **2** illustrates an example of preferential processing. Here the blockchain load balancing mechanism **60** may allocate the private blockchains **20***a-c* based on financial transactions associated with cryptographic coinage (or "cryptocoinage") **70**. The blockchain load balancing mechanism **60** may operate in a blockchain environment **72** in which each entity **28***a-c* may create and issue its own private cryptocoinage **70***a-c*. The inventor predicts that as more and more businesses adopt blockchain technology, more and more businesses will issue their own, private cryptocoinage **70**. Indeed, as many people are expected to adopt the private cryptocoinage **70** issued by different financial institutions, national retailers (such as HOME DEPOT®, KOHL'S®, or WALMART®), and popular website services (such as AMAZON®, NETFLIX®, or GOOGLE®), the inventor expects that the many different private blockchains **20***a-c* will contain data representing millions or billions of financial transactions per day. The blockchain load balancing mechanism **60** may thus determine how the data layer server **24** is shared to ensure the blockchain data layer **40** adequately validates the financial transactions. The blockchain load balancing mechanism **60** thus allocates the processing and memory capabilities of the data layer server **24** to process each entity's private cryptocoinage **70***a-c*.

The load parameter **22** may thus represent financial transactions. Blockchain **20***a*, for example, may contain blocks **74***a* of data representing financial transactions **76***a* associated with the entity's private cryptocoinage **70***a*. Blockchains **20***b* and **20***c* would similarly contain blocks **74***b-c* of data representing financial transactions **76***b-c* associated with the entity's private cryptocoinage **70***b-c*. As the blockchains **20***a-c* stream as inputs to the data layer server **24**, the blockchain load balancing mechanism **60** determines a rate **78** of the financial transactions **76** that corresponds to each different blockchain **20***a-c*. While the rate **78** may be measured or defined according to any measure, most readers are thought familiar with a count or sum of the financial transactions **76** per unit time (such as seconds, minutes, hours, or per day). The blockchain load balancing mechanism **60** may read, inspect, or sample any of the blockchains **20** and count or sum any blocks **74** of data representing a financial transaction **76** occurring within a window of time. The blockchain load balancing mechanism **60** computes or determines the rate **78** (e.g., number of the financial transactions **76** per second). The blockchain load balancing mechanism **60** may then use the rate **78** to determine how the multiple blockchains **20***a-c* share, consume, or monopolize the processing capabilities of the data layer server **24** and/or the blockchain data layer **40**.

FIG. **3** illustrates virtual computing. Here the blockchain load balancing mechanism **60** manages virtual machines (or "VM") **80** sharing the data layer server **24**. The data layer server **24** may provide virtual computing and/or virtual hardware resources to client devices (such as the entity servers **26***a-c*). The data layer server **24** may lend or share its hardware, computing, and programming resources with any of the entity servers **26***a-c*. The data layer server **24** thus operates or functions as a virtual, remote resource for generating the blockchain data layer **40**. The data layer server **24** may present or operate as one or more virtual machines **80**. Each one of the virtual machines **80** may provide its processing or application resource to any of the entity servers **26***a-c*. While FIG. **3** only illustrates four (4) virtual machines **80***a-d*, the number or instantiations may be several or even many, depending on complexity and resources.

Load balancing may be desired. As the data layer server **24** may provide resources to many different entity servers **26**, optimal management techniques may be desired. That is, as the entity servers **26** make requests for data or processing, some of the shared resources in the data layer server **24** may be over utilized. The blockchain load balancing mechanism **60** may thus balance or distribute processing and/or memory loads among the virtual machines **80**. The blockchain load balancing mechanism **60** may assign or distribute one of the private blockchains **20** to a particular virtual machine **80** for processing. Suppose, for example, that each virtual machine **80***a-d* is assigned a corresponding share **82***a-c* of the total resources of the data layer server **24**. As the private blockchains **20***a-c* are received as inputs, the blockchain load balancing mechanism **60** inspects the private blockchains **20***a-c* and determines a corresponding processing ratio **84***a-c* (which later paragraphs will explain in more detail). The blockchain load balancing mechanism **60** may then assign a particular one of the virtual machines **80***a-c*, based on the processing ratio **84***a-c* and the share **82***a-c* assigned to each virtual machine **80***a-c*. Each private blockchain **20**, in other words, may be assigned a processing bandwidth or slice of the data layer server **24** according to its processing load or burden.

FIG. **4** illustrates another example of preferential processing. Suppose that the blockchain load balancing mechanism **60** awards, recognizes, or applies a priority **90** to the private blockchain **20***a*. The priority **90** may be based on any factor or parameter (such as the load parameter **22**). Here, though, the priority **90** may be based on a processing fee **92**. That is, the entity **28***a* may, somehow, pay the higher or greater processing fee **92** for expedited processing of its private blockchain **20***a*. When the data layer server **24** and/or in the blockchain data layer **40** receive and/or process the private blockchain **20***a*, exemplary embodiments may prioritize the entity's private blockchain **20***a*, in response to payment of the processing fee **92**. Suppose, for example, that the processing fee **92** is paid in credits, tokens, or other cryptocurrency. The processing fee **92**, of course, may also be paid in conventional currency. Regardless, the data layer server **24** and/or the blockchain data layer **40** may thus dedicate a disproportionate or unequal share of its hardware and/or software processing capabilities to the private blockchain **20***a*. When the blockchain load balancing mechanism **60** no longer designates the priority **90** to the private blockchain **20***a*, the data layer server **24** and/or the blockchain data layer **40** may then commence or resume processing any of the other private blockchains **20***b* or **20***c*.

FIG. **5** illustrates another example of preferential processing. Here the load parameter **22** may be based on a processing time **94**. Each private blockchain **20***a-c*, in other words, may be processed when a current time **96** (perhaps determined by an internal or network clock) matches or coincides with the corresponding processing time **94** assigned to each private blockchain **20***a-c*. When the current time **96** equals, matches, or otherwise corresponds to a particular one of the processing times **94**, then the data layer server **24** and/or the blockchain data layer **40** may begin or commence processing the corresponding private blockchain **20**. The blockchain load balancing mechanism **60** may be configured with an optional, corresponding stop time **98** at which the data layer server **24** and/or the blockchain data layer **40** stops preferential processing of the private blockchain **20***a-c*. A simple example may be that blockchain **20***c* is associated with a daily 3 am processing time **94**. At 3 am, in other words, the data layer server **24** and/or the blockchain data layer **40** starts dedicating its hardware/software resources to the blockchain **20***c*. If the stop time **98** is 5 am, then exemplary embodiments may solely, or preferably, process the blockchain **20***c* for a two-hour interval, before the other blockchains **20***a* and **20***b* are processed. The blockchain load balancing mechanism **60** may thus implement a recurring interval in which the priority **90** may be applied. However, if the blockchain **20***c* is entirely processed prior to the 5 am stop time **98**, then exemplary embodiments may transition to processing of the other blockchains **20***a* and **20***b*. The blockchain load balancing mechanism **60** may thus be configured prioritize processing according to a daily schedule.

FIG. **6** illustrates calendar-based preferential processing. Here each private blockchain **20***a-c* may be associated with a corresponding calendar entry **100** (e.g., date and time) for processing. The blockchain load balancing mechanism **60** compares the current time **96** (e.g., day and time) to the calendar entry **100** associated with each blockchain **20***a-c*. When the current time **96** matches or coincides with the calendar entry **100**, the blockchain load balancing mechanism **60** may instruct the data layer server **24** and/or the blockchain data layer **40** to commence processing. Processing may continue until the private blockchain **20** is exhausted (that is, all blocks of data received by the private blockchain **20** have been processed). The blockchain load balancing mechanism **60**, however, may stop processing, or commence shared processing, at the corresponding stop time **98** (e.g., day and time), such as when the calendar entry **100** expires.

FIGS. **7-9** are more detailed illustrations of an operating environment, according to exemplary embodiments. FIG. **7** illustrates the entity server **26** communicating with a data layer server **24** via a communications network **110**. The entity server **26** operates on behalf of the entity **28** and generates the entity's private blockchain **20**. The entity server **26**, in other words, has a processor **112** (e.g., "μP"), application specific integrated circuit (ASIC), or other component that executes the entity's software application **34** stored in a local memory device **114**. The entity server **26** has a network interface to the communications network **110**, thus allowing two-way, bidirectional communication with the data layer server **24**. The entity's software application **34** includes instructions, code, and/or programs that cause the entity server **26** to perform operations, such as calling, invoking, and/or applying an electronic representation of a hashing algorithm **120** to the entity's private data **32**. The hashing algorithm **120** thus generates one or more hash values **122**, which are incorporated into the blocks **74** of data within the entity's private blockchain **20**. The entity's software application **34** then instructs the entity server **26** to send the private blockchain **20** via the communications network **110** to any network address, such as an Internet protocol address associated with the data layer server **24**.

FIG. **8** illustrates the blockchain data layer **40**. The data layer server **24** has a processor **130** (e.g., "μP"), application specific integrated circuit (ASIC), or other component that executes a data layer application **132** stored in a local memory device **134**. The data layer server **24** has a network interface to the communications network **110**. The data layer application **132** includes instructions, code, and/or programs that cause the data layer server **24** to perform operations, such as receiving the entity's private blockchain **20**. The data layer application **132** may then call or invoke the blockchain load balancing mechanism **60** (perhaps as a software module or via an API) to allocate resources (such as the processor **130** and/or the local memory device **134**) to the private blockchain **20**, perhaps according to the load parameter **22**. The data layer application **132** causes the data layer server **24** to generate the blockchain data layer **40**. The data layer application **132** may optionally call, invoke, and/or apply the hashing algorithm **120** to the data records **38** contained within the blockchain data layer **40**. The data layer application **132** may also generate the public blockchain **50**. The data layer application **132** may thus generate the public ledger **52** that publishes, records, or documents the cryptographic proof **48** of the blocks of data contained within the private blockchain **20**.

FIG. **9** illustrates additional publication mechanisms. Once the blockchain data layer **40** is generated, the blockchain data layer **40** may be published in a decentralized manner to any destination. The data layer server **24**, for example, may generate and distribute the public blockchain **50** (via the communications network **110** illustrated in FIGS. **7-8**) to one or more federated servers **140**. While there may be many federated servers **140**, for simplicity FIG. **9** only illustrates two (2) federated servers **140***a* and **140***b*. The federated servers **140***a* and **140***b* provide a service and, in return, they are compensated according to a compensation or services agreement or scheme.

Exemplary embodiments include still more publication mechanisms. For example, the cryptographic proof **48** and/or the public blockchain **50** may be sent (via the communications network **110** illustrated in FIGS. **7-8**) to a server **142**. The server **142** may then add another, third layer of cryptographic hashing (perhaps using the hashing algorithm **120**) and generate another or second public blockchain **144**. While the server **142** and/or the public blockchain **144** may be operated by, or generated for, any entity, exemplary embodiments may integrate another cryptographic coin mechanism. That is, the server **142** and/or the public blockchain **144** may be associated with BITCOIN®, ETHEREUM®, RIPPLE®, or other cryptographic coin mechanism. The cryptographic proof **48** and/or the public blockchain **50** may be publically distributed and/or documented as evidentiary validation. The cryptographic proof **48** and/or the public blockchain **50** may thus be historically and publically anchored for public inspection and review.

Exemplary embodiments may be applied regardless of networking environment. Exemplary embodiments may be easily adapted to stationary or mobile devices having cellular, wireless fidelity (WI-FI®), near field, and/or BLUETOOTH® capability. Exemplary embodiments may be applied to mobile devices utilizing any portion of the electromagnetic spectrum and any signaling standard (such as the IEEE 802 family of standards, GSM/CDMA/TDMA or any cellular standard, and/or the ISM band). Exemplary embodiments, however, may be applied to any processor-controlled device operating in the radio-frequency domain and/or the Internet Protocol (IP) domain. Exemplary embodiments may be applied to any processor-controlled device utilizing a distributed computing network, such as the Internet (sometimes alternatively known as the "World Wide Web"), an intranet, a local-area network (LAN), and/or a wide-area network (WAN). Exemplary embodiments may be applied to any processor-controlled device utilizing power line technologies, in which signals are communicated via electrical wiring. Indeed, exemplary embodiments may be applied regardless of physical componentry, physical configuration, or communications standard(s).

Exemplary embodiments may utilize any processing component, configuration, or system. Any processor could be multiple processors, which could include distributed processors or parallel processors in a single machine or multiple machines. The processor can be used in supporting a virtual processing environment. The processor could include a state machine, application specific integrated circuit (ASIC), programmable gate array (PGA) including a Field PGA, or state machine. When any of the processors execute instructions to perform "operations," this could include the processor performing the operations directly and/or facilitating, directing, or cooperating with another device or component to perform the operations.

Exemplary embodiments may packetize. When the entity server **26** and the data layer server **24** communicate via the communications network **110**, the entity server **26** and the data layer server **24** may collect, send, and retrieve information. The information may be formatted or generated as packets of data according to a packet protocol (such as the Internet Protocol). The packets of data contain bits or bytes of data describing the contents, or payload, of a message. A header of each packet of data may contain routing information identifying an origination address and/or a destination address.

FIGS. **10-14** further illustrate the blockchain data layer **40**, according to exemplary embodiments. The blockchain data layer **40** chains hashed directory blocks **150** of data into the public blockchain **50**. For example, the blockchain data layer **40** accepts input data (such as the one or more private blockchains **20** illustrated in FIGS. **1-8**) within a window of time. While the window of time may be configurable from fractions of seconds to hours, exemplary embodiments use ten (10) minute intervals. FIG. **10** illustrates a simple example of only three (3) directory blocks **150***a-c* of data, but in practice there may be millions or billions of different blocks. Each directory block **150** of data is linked to the preceding blocks in front and the following or trailing blocks behind. The links are created by hashing all the data within a single directory block **150** and then publishing that hash value within the next directory block.

As FIG. **11** illustrates, published data may be organized within chains **152**. Each chain **152** is created with an entry that associates a corresponding chain identifier **154**. Each entity **28***a-f*, in other words, may have its corresponding chain identifier **154***a-d*. The blockchain data layer **40** may thus track any data associated with the entity **28***a-f* with its corresponding chain identifier **154***a-d*. New and old data in time may be associated with, linked to, identified by, and/or retrieved using the chain identifier **154***a-d*. Each chain identifier **154***a-d* thus functionally resembles a directory **156***a-d* (e.g., files and folders) for organized data entries according to the entity **28***a-f*.

FIG. **12** illustrates the data records **38** in the blockchain data layer **40**. As data is received as an input (such as the private blockchain(s) **20** illustrated in FIGS. **1-8**), data is recorded within the blockchain data layer **40** as an entry **160**. While the data may have any size, small chunks (such as 10 KB) may be pieced together to create larger file sizes. One or more of the entries **160** may be arranged into entry blocks **162** representing each chain **152** according to the corresponding chain identifier **154**. New entries for each chain **152** are added to their respective entry block **162** (again perhaps according to the corresponding chain identifier **154**). After the entries **160** have been made within the proper entry blocks **162**, all the entry blocks **162** are then placed within in the directory block **150** generated within or occurring within a window **164** of time. While the window **164** of time may be chosen within any range from seconds to hours, exemplary embodiments may use ten (10) minute intervals. That is, all the entry blocks **162** generated every ten minutes are placed within in the directory block **150**.

FIG. **13** illustrates cryptographic hashing. The data layer server **24** executes the data layer application **132** to generate the data records **38** in the blockchain data layer **40**. The data layer application **132** may then instruct or cause the data layer server **24** to execute the hashing algorithm **120** on the data records **38** (such as the directory block **150** explained with reference to FIGS. **10-12**). The hashing algorithm **120** thus generates one or more hash values **166** as a result, and the hash values **166** represent the hashed data records **38**. As one example, the blockchain data layer **40** may apply a Merkle tree analysis to generate a Merkle root (representing a Merkle proof **48**) representing each directory block **150**.

The blockchain data layer **40** may then publish the Merkle proof **48** (as this disclosure explains).

FIG. **14** illustrates hierarchical hashing. The entity's private software application **34** provides a first layer **170** of cryptographic hashing and generates the private blockchain **20**. The entity **28** then sends its private blockchain **20** to the data layer server **24**. The data layer server **24**, executing the data layer application **132**, generates the blockchain data layer **40**. The data layer application **132** may optionally provide a second or intermediate layer **172** of cryptographic hashing to generate the cryptographic proof **48**. The data layer application **132** may also publish any of the data records **38** as the public blockchain **50**, and the cryptographic proof **48** may or may not also be published via the public blockchain **50**. The public blockchain **50** and/or the cryptographic proof **48** may be optionally sent to the server **142** as an input to yet another public blockchain **144** (again, such as BITCOIN®, ETHEREUM®, or RIPPLE®) for a third layer **174** of cryptographic hashing and public publication. The first layer **170** and the second layer **172** thus ride or sit atop a conventional public blockchain **144** (again, such as BITCOIN®, ETHEREUM®, or RIPPLE®) and provide additional public and/or private cryptographic proofs **48**.

Exemplary embodiments may use any hashing function. Many readers may be familiar with the SHA-256 hashing algorithm. The SHA-256 hashing algorithm acts on any electronic data or information to generate a 256-bit hash value as a cryptographic key. The key is thus a unique digital signature. There are many hashing algorithms, though, and exemplary embodiments may be adapted to any hashing algorithm.

FIGS. **15-18** illustrate the virtual computing environment, according to exemplary embodiments. Here the blockchain load balancing mechanism **60** manages the virtual machines ("VM") **80** that share the data layer server **24**. Virtual computing is known, so this disclosure need not dwell on known details. Suffice it to say that the data layer server **24** may present or operate as the one or more virtual machines **80**. That is, the entity servers **26***a-c* and/or their corresponding private blockchains **20***a-c* may share the capabilities of the processor **130** and the memory device **134** via the virtual machines **80**.

Load balancing may be desired. The blockchain load balancing mechanism **60** may query an electronic database **180** to determine virtual assignments. That is, the blockchain load balancing mechanism **60** may assign or distribute any of the private blockchains **20** to a particular one of the virtual machines **80** according to the informational content within the electronic database **180**. FIG. **15** illustrates the data layer server **24** locally storing the database **180** in its local memory device **134**, but the electronic database **180** may be remotely stored and accessed via the communications network **110** (illustrated in FIGS. **7-8**). Regardless, the data layer server **24** may query the database **180** for a query parameter and identify the corresponding virtual machine **80**.

FIG. **16** illustrates the electronic database **180**. Here the database **180** may define assignments between the private blockchains **20** and their corresponding virtual machine **80**. While the database **180** may have any logical structure, FIG. **16** illustrates the database **180** as a table **182** that maps, converts, or translates the private blockchain **20** to its corresponding virtual machine **80**. As a simple example, suppose the database **180** configured with entries that relate the chain ID **154** to its corresponding virtual machine **80**. The blockchain load balancing mechanism **60** may instruct the data layer server **24** to query for the chain ID **154** and identify and/or retrieve an address, processor core, identifier, or other indicator assigned to the corresponding virtual machine **80**. The database **180** may optionally contain entries that relate hashed values of the chain ID **154**. Regardless, once the virtual machine **80** is identified, the blockchain load balancing mechanism **60** may direct or assign the private blockchain **20** to the virtual machine **80** for processing.

FIG. **17** further illustrates the database **180** of virtual machines. Here the database **180** of virtual machines may specify the share **82** assigned to each virtual machine **80**. The data layer server **24** and/or the blockchain data layer **40** has a total resource capability or utilization **184** associated with the processor **130** and/or the memory device **134**. There are many known measures and schemes for determining resource capability and utilization, and exemplary embodiments may utilize any of the known measures and schemes. For simplicity, then, thus disclosure will assume that the total resource capability or utilization **184** is one hundred percent (100%). Each virtual machine **80** may thus be assigned its corresponding share **82** of the total resource capability or utilization **184**. The database **180** may thus be preconfigured or preloaded with entries that assign or associate each virtual machine **80** to its corresponding share **82**. As the data layer server **24** receives one or more of the private blockchains **20**, the blockchain load balancing mechanism **60** may determine a blockchain processing requirement **186** associated with the private blockchain **20**. The blockchain processing requirement **186** may be the resources required of the processor **130** and/or the memory device **134** to process the private blockchains **20**, to generate the blockchain data layer **40**, and/or to compute or determine any other value or measure (such as the data records **38** and/or the rate **78** of the financial transactions, as explained with reference to FIG. **2**). For example, the blockchain load balancing mechanism **60** may compute or determine a blockchain ratio **188** of the blockchain processing requirement **186** to the total resource capability or utilization **184** available from the data layer server **24**. The blockchain load balancing mechanism **60** may query the database **180** for the blockchain ratio **188** to identify the corresponding virtual machine **80**. Exemplary embodiments may thus determine whether the blockchain ratio **188** matches any of the shares **82** specified by the database **180**. Once the virtual machine **80** is identified, the blockchain load balancing mechanism **60** may direct or assign the private blockchain **20** to the corresponding virtual machine **80** for processing. Each private blockchains **20** may thus be assigned a processing bandwidth or slice of the data layer server **24** according to its processing load or burden.

FIG. **18** further illustrates the database **180**. Here the database **180** may specify the shares **82** as ranges **190** of values. One virtual machine **80**, for example, may be assigned to private blockchains **20** requiring heavy, disproportionate, or abnormally large use of the data layer server **24** and/or the blockchain data layer **40**. Another one of the virtual machines **80**, as another example, may be assigned to private blockchains **20** requiring medium, intermediate, or historically average use of the data layer server **24** and/or the blockchain data layer **40**. Still another virtual machine **80** may be reserved for the private blockchains **20** that only require light, low, or historically below average use of the data layer server **24** and/or the blockchain data layer **40**. As the data layer server **24** receives any of the private blockchains **20**, the blockchain load balancing mechanism **60** may again compute or determine the blockchain ratio **188** and consult the database **180**. If the blockchain ratio **188** lies within, matches, or favorably compares to any of the ranges **190** of the shares **82** specified by the database **180**, then the blockchain load balancing mechanism **60** directs the private blockchain **20** to the corresponding virtual machine **80**.

FIGS. **19-20** illustrate bandwidths, according to exemplary embodiments. Here the blockchain load balancing mechanism **60** may assign the private blockchain **20** based on bit processing capabilities. The processor **130** within the data layer server **24** may have a limited capability to accept and/or process bits of information. When the private blockchain **20** is received, the private blockchain **20** may be represented by bits or bytes. Sometimes the number of bits/bytes received may exceed the number of bits/bytes that cab be serially or sequentially processed by the processor **130**. Similarly, the memory device **134** may also have a limited capability to accept and/or process bits or bytes. Indeed, it may be common for the data layer server **24** to allocate or set aside a portion of the memory device **134** as a cache memory for an overflow of bits/bytes. The blockchain load balancing mechanism **60** may thus establish a processor bandwidth **200** specifying a permissible amount of bits/second that may be received, accepted, and/or processed by the processor **130**. The blockchain load balancing mechanism **60** may also retrieve or identify a memory bandwidth **202** specifying a permissible amount of bits/second that may be received, accepted, and/or processed by the memory device **134**.

The database **180** may specify the bandwidths. The database **180** may be preloaded or preconfigured with the processor bandwidth **200** and/or the memory bandwidth **202** assigned to each virtual machine **80**. As the data layer server **24** receives the private blockchain **20**, the data layer application **132** (executing or applying the blockchain load balancing mechanism **60**) may determine the corresponding blockchain processor bandwidth **204** (perhaps in bits per second) that is required of the processor **130** to process the private blockchain **20**. The blockchain load balancing mechanism **60** may also determine the corresponding blockchain memory bandwidth **206** (perhaps in bits per second) that is required of the memory device **134** to process the private blockchain **20**. The blockchain load balancing mechanism **60** may query the database **180** for the blockchain processor bandwidth **204** and/or the blockchain memory bandwidth **206** to identify the corresponding virtual machine **80**. If the blockchain processor bandwidth **204** and/or the blockchain memory bandwidth **206** match or satisfy a range of values associated with an entry, then the blockchain load balancing mechanism **60** may assigned the private blockchain **20** to the corresponding virtual machine **80**. Once the virtual machine **80** is identified, the blockchain load balancing mechanism **60** may establishes any other parameters for processing.

FIG. **20** illustrates a bit rate **210**. Because the blockchain load balancing mechanism **60** may determine or count the bits per second, the virtual machines **80** may be assigned based on the bit rate **210**. As the data layer server **24** receives the private blockchain **20**, the data layer application **134** (executing or applying the blockchain load balancing mechanism **60**) may determine the bit rate **210** of the private blockchain **20**. The bit rate **210** may represent the bits per second during a receipt of the private blockchain **20** (such as by the network interface, by the processor **130**, and/or by the memory device **134**). Exemplary embodiments may count the bits received and compare to the entries in the electronic database **180**. If the database **180** has an entry that matches or satisfies the bit rate **210** and/or a range of the bit rate **210**, exemplary embodiments identify the corresponding virtual machine **80**. Once the virtual machine **80** is identified, the blockchain load balancing mechanism **60** may direct or assign the private blockchain **20** to the virtual machine **80** for processing.

The bit rate **210** may thus determine the virtual machine **80**. One of the virtual machines **80** may be reserved for private blockchains **20** having a heavy, disproportionate, or abnormally large bit rate **210**. Another virtual machine **80** may be reserved for private blockchains **20** having a medium, intermediate, or historically average bit rate **210**. Still another one of the virtual machines **80** may be reserved for the private blockchains **20** having a light, low, or historically below average bit rate **210**. The resources available from the data layer server **24** and/or the blockchain data layer **40** may be assigned based on slices or portions as determined by the bit rate **210**.

FIG. **21** illustrates the financial transactions **76** per second, according to exemplary embodiments. Here the blockchain load balancing mechanism **60** may assign the virtual machine **80** based on the rate **78** of the financial transactions **76** per second represented by the private blockchain **20**. As this disclosure previously explained, the private blockchain **20** may represent one or more financial transactions **76** involving the entity's private cryptocoinage **70**. Each different financial transaction **76** may be represented by a unique or different hash value recorded in the block **74** of data incorporated into the private blockchain **20**. Each different financial transaction **76** may additionally or alternatively be represented by a unique identifier or address (such as the chain ID **154**, or other indicator. Regardless, as the private blockchain **20** is received, the blockchain load balancing mechanism **60** may inspect, read, or view the blocks **74** of data and count or sum the number of the transactions **74** per second. Exemplary embodiments may then query or consult the database **180** to determine the corresponding virtual machine **80**. As FIG. **21** illustrates, the electronic database **180** may have entries that map or electronically associate different values or ranges of the rate **78** to their corresponding virtual machine(s) **80**. If the database **180** has an entry that matches or satisfies the rate **78** of the financial transactions **76**, exemplary embodiments identify the corresponding virtual machine **80**. Once the virtual machine **80** is identified, the blockchain load balancing mechanism **60** may direct or assign the private blockchain **20** to the virtual machine **80** for processing.

The rate **78** of the financial transactions **76** may thus determine the virtual machine **80**. One of the virtual machines **20** may be reserved for private blockchains **20** having a heavy, disproportionate, or abnormally large number of the transactions **76** per second. Another virtual machine **80** may be reserved for private blockchains **20** having a medium, intermediate, or historically average number of the transactions **76** per second. Another virtual machine **80** may be reserved for the private blockchains **20** having a light, low, or historically below average number of the transactions **76** per second. The resources available from the data layer server **24** and/or the blockchain data layer **40** may be assigned based on slices or portions as determined by the cryptocoinage transactions **76** per second.

The private cryptocoinage **70** may be required to access the private blockchain **20**. The entity **28**, for example, may require that a user spend or redeem a credit token (not shown for simplicity) of the private cryptocoinage **70**. The user, for example, may burn one or more of credit tokens to access the blocks of data and/or hash values incorporated into the private blockchain **20**. The credit token may or may not be transferrable, depending on policies established by the entity

28. A tradeable token (again not shown for simplicity) may also be established, and the tradeable token may be bought, sold, and/or earned, again according to the policies established by the entity **28**. Regardless, the private cryptocoinage **70** must be consumed to access, read, or otherwise use the entity's private blockchain **20**.

FIG. **22** illustrates allocations based on the blockchain data layer **40**, according to exemplary embodiments. As this disclosure previously explained, the data layer server **24** receives the private blockchain **20** and generates the data records **38** representing the blockchain data layer **40** (such as the entries **160**, entry blocks **162**, and/or the directory blocks **150** explained with reference to FIGS. **10-12**). The blockchain load balancing mechanism **60** may thus assign the virtual machine **80** based on the number of the entries **160**, the entry blocks **162**, and/or the directory blocks **150** associated with the private blockchain **20**. For example, as the data records **38** are generated, the blockchain load balancing mechanism **60** may determine a rate **220** of generation. That is, as the data records **38** are generated for any private blockchain **20**, exemplary embodiments may sum or count the entries **160**, the entry blocks **162**, and/or the directory blocks **150** that are generated over time (such as per second, per minute, or other interval). The blockchain load balancing mechanism **60**, for example, calls or initializes a counter having an initial value (such as zero). At an initial time, the counter commences or starts counting or summing the number of the entries **160**, entry blocks **162**, and/or the directory blocks **150** (generated within the blockchain data layer **40**) that are commonly associated with or reference the private blockchain **20** (perhaps according to the chain ID **154** representing the entity's private cryptocoinage **70**). The counter stops counting or incrementing at a final time and exemplary embodiments determine or read the final value or count. Exemplary embodiments may then calculate the rate **220** of generation as the sum or count over time and consult or query the electronic database **180** for the rate **220** of generation. The electronic database **180** may thus define entries that map or associate different rates **220** of generation and/or ranges to their corresponding virtual machines **80**. If the database **180** of virtual machines has an entry that matches or satisfies the rate **220** of generation, exemplary embodiments identify the corresponding virtual machine **80**. Once the virtual machine **80** is identified, the blockchain load balancing mechanism **60** may direct or assign the private blockchain **20** to the virtual machine **80** for processing.

The rate **220** of generation may thus be a feedback mechanism. As the private blockchains **20** are received, the rate **220** of generation of the data records **38** may determine the virtual machine **80** assigned adequate capacity or bandwidth. Again, one of the virtual machines **20** may be reserved for private blockchains **20** having a heavy, disproportionate, or abnormally large rate **220** of generation. Another virtual machine **80** may be reserved for private blockchains **20** having a medium, intermediate, or historically average rate **220** of generation. Another virtual machine **80** may be reserved for the private blockchains **20** having a light, low, or historically below average rate **220** of generation. The rate **220** of generation may thus be a gauge or measure of which virtual machine **80** is assigned the resources that process the private blockchain **20**.

FIG. **23** illustrates dynamic operation, according to exemplary embodiments. As the data layer server **24** operates, the volume or number of the private blockchains **20** may increase or decrease over time. Sometimes many different private blockchains **20** are fed as inputs to the data layer server **24**, and at other times only a few or a single private blockchain **20** is received. In other words, as the private blockchains **20** start, stop, and/or terminate as inputs, the chain ID(s) **154** and/or the blocks **74** of data will dynamically change. Moreover, as time progresses, other parameters affecting the blockchain load balancing mechanism **60** may additionally or alternatively change. For example, the blockchain ratio **188**, the processor bandwidth **200** and the memory bandwidth **202**, and the total resources **184** available from the data layer server **24** may dynamically change. The bit rates **210**, the rate **78**, and/or the rate **220** of generation may also dynamically change (as this disclosure above explained). The blockchain load balancing mechanism **60** may thus dynamically re-evaluate the assignments of the virtual machines **80** according to a timing parameter **222**. The timing parameter **222** may have any value, or range of values, from fractions of a second (e.g., picoseconds) to hours. The blockchain load balancing mechanism **60** may thus execute or re-execute according to the timing parameter **222**. As a simple example, the blockchain load balancing mechanism **60** may call or initialize a timer that starts incrementing or decrementing from an initial value at an initial time. The timer may then expire at a final time. The blockchain load balancing mechanism **60** may evaluate any assignment of the virtual machine **80** as the timer increments or at the expiration. Regardless, when the timer reinitializes and again begins, the blockchain load balancing mechanism **60** may repeat the assignment of the virtual machine **80**.

FIGS. **24-25** illustrate web access, according to exemplary embodiments. Here the blockchain load balancing mechanism **60** may be accessed and configured via the communications network **110** (such as the Internet, as illustrated with reference to FIGS. **7-8**). FIG. **24** thus illustrates the blockchain load balancing mechanism **60** as a software-as-a-service offered by the secure data layer server **24**. The blockchain load balancing mechanism **60**, for example, may be a module within, or called by, the data layer application **132**. A user accesses the blockchain load balancing mechanism **60** to define the various parameters governing load balancing. While the blockchain load balancing mechanism **60** may have any access mechanism, FIG. **24** illustrates a web interface **230**. That is, the blockchain load balancing mechanism **60** may be accessed via a webpage **232**. The webpage **232** prompts the user to input or to select one or more parameters governing the blockchain load balancing mechanism **60**.

FIG. **25** further illustrates the web interface **230**. The user accesses the blockchain load balancing mechanism **60** using a user device **240**. While the user device **240** may be any processor-controlled device, most readers are familiar with a smartphone **242**. If the smartphone **242** correctly sends authentication credentials, then the smartphone **242** may utilize the web interface **230** to the data layer server **24** and/or the blockchain data layer **40**. The smartphone **242** executes a web browser and/or a mobile application to send a request **244** specifying an address or domain name associated with or representing the data layer server **24** and/or the blockchain load balancing mechanism **60**. The web interface **230** to the data layer server **24** thus sends the webpage **232** as a response, and the user's smartphone **242** downloads the webpage **232**. The smartphone **242** has a processor and memory device that executes (not shown for simplicity) that causes a display of the webpage **232** as a graphical user interface (or "GUI") **246** on its display device **248**. The GUI **246** may generate one or more prompts or fields for specifying the parameters defining the blockchain load balancing mechanism **60**. As one example, the webpage

232 may have prompts or fields for specifying the entries in the electronic database **180**. Once the parameters or entries are specified, the blockchain load balancing mechanism **60** may commence operation.

FIG. **26** illustrates a public entity **250**, according to exemplary embodiments. Here exemplary embodiments may be applied to any public data **252** generated by the public entity **250**. The public entity **250** may be a city, state, or federal governmental agency, but the public entity **250** may also be a contractor, non-governmental organization, or other actor that acts on behalf of the governmental agency. The public entity **250** operates its corresponding public server **254** and applies its software application **256** to its public data **252** to generate its governmental blockchain **258**. The data layer server **24** receives the governmental blockchain **258** and generates the blockchain data layer **40**. The data layer server **24** may also execute the blockchain load balancing mechanism **60** to share resources between the governmental blockchain **238***a-b*, as this disclosure explains.

FIG. **27** is a flowchart illustrating a method or algorithm for load balancing of the blockchains **20** and **258**, according to exemplary embodiments. The electronic private data **32** is generated (Block **300**), hashed (Block **302**), and incorporated into the private blockchain **20** (Block **304**). The private blockchain **20** is received by the data layer server **24** (Block **306**) and the blockchain load balancing mechanism **60** allocates resources (Block **308**). The data records **38** in the blockchain data layer **40** are generated (Block **310**). The data records **38** in the blockchain data layer **40** may be hashed (Block **312**) and incorporated into the public blockchain **50** (Block **314**).

FIG. **28** is a schematic illustrating still more exemplary embodiments. FIG. **28** is a more detailed diagram illustrating a processor-controlled device **350**. As earlier paragraphs explained, the entity's private software application **34** and/or the data layer application **132** may partially or entirely operate in any mobile or stationary processor-controlled device. FIG. **28**, then, illustrates the entity's private software application **34** and/or the data layer application **132** stored in a memory subsystem of the processor-controlled device **350**. One or more processors communicate with the memory subsystem and execute either, some, or all applications. Because the processor-controlled device **350** is well known to those of ordinary skill in the art, no further explanation is needed.

FIG. **29** depicts other possible operating environments for additional aspects of the exemplary embodiments. FIG. **29** illustrates the entity's private software application **34** and/or the data layer application **132** operating within various other processor-controlled devices **350**. FIG. **29**, for example, illustrates that the entity's private software application **34** and/or the data layer application **132** may entirely or partially operate within a set-top box ("STB") (**352**), a personal/digital video recorder (PVR/DVR) **354**, a Global Positioning System (GPS) device **356**, an interactive television **358**, a tablet computer **360**, or any computer system, communications device, or processor-controlled device utilizing any of the processors above described and/or a digital signal processor (DP/DSP) **362**. Moreover, the processor-controlled device **350** may also include wearable devices (such as watches), radios, vehicle electronics, clocks, printers, gateways, mobile/implantable medical devices, and other apparatuses and systems. Because the architecture and operating principles of the various devices **350** are well known, the hardware and software componentry of the various devices **350** are not further shown and described.

Exemplary embodiments may be applied to any signaling standard. Most readers are thought familiar with the Global System for Mobile (GSM) communications signaling standard. Those of ordinary skill in the art, however, also recognize that exemplary embodiments are equally applicable to any communications device utilizing the Time Division Multiple Access signaling standard, the Code Division Multiple Access signaling standard, the "dual-mode" GSM-ANSI Interoperability Team (GAIT) signaling standard, or any variant of the GSM/CDMA/TDMA signaling standard. Exemplary embodiments may also be applied to other standards, such as the I.E.E.E. 802 family of standards, the Industrial, Scientific, and Medical band of the electromagnetic spectrum, BLUETOOTH®, and any other.

Exemplary embodiments may be physically embodied on or in a computer-readable storage medium. This computer-readable medium, for example, may include CD-ROM, DVD, tape, cassette, floppy disk, optical disk, memory card, memory drive, and large-capacity disks. This computer-readable medium, or media, could be distributed to end-subscribers, licensees, and assignees. A computer program product comprises processor-executable instructions for load balancing, as the above paragraphs explain.

While the exemplary embodiments have been described with respect to various features, aspects, and embodiments, those skilled and unskilled in the art will recognize the exemplary embodiments are not so limited. Other variations, modifications, and alternative embodiments may be made without departing from the spirit and scope of the exemplary embodiments.

The invention claimed is:

1. A method executed by a server that load balances virtual machines processing blockchains, the method comprising:

receiving, by the server, the blockchains as inputs;

determining, by the server, a parameter associated with a corresponding blockchain of the blockchains;

identifying, by the server, a virtual machine of the virtual machines by querying an electronic database that electronically associates the virtual machines to blockchain parameters including the parameter associated with the corresponding blockchain;

load balancing, by the server, the virtual machines to the blockchains by executing a blockchain load balancing mechanism that assigns the virtual machine to the corresponding blockchain;

sending, by the server, the corresponding blockchain to the virtual machine for the processing.

2. The method of claim **1**, further comprising receiving blockchain transactions associated with the corresponding blockchain.

3. The method of claim **2**, further comprising determining a number of the blockchain transactions associated with the corresponding blockchain.

4. The method of claim **3**, further comprising assigning the virtual machine to the corresponding blockchain based on the number of the blockchain transactions associated with the corresponding blockchain.

5. The method of claim **1**, further comprising receiving cryptographic coinage transactions associated with the corresponding blockchain.

6. The method of claim **1**, further comprising determining a bit rate associated with the corresponding blockchain.

7. The method of claim **6**, further comprising assigning the virtual machine to the corresponding blockchain based on the bit rate.

8. A server that load balances virtual machines processing blockchains, the server comprising:
- a hardware processor; and
- a memory device storing instructions that when executed by the hardware processor perform operations, the operations comprising:
- receiving the blockchains as inputs;
- determining a parameter associated with a corresponding blockchain of the blockchains;
- identifying a virtual machine of the virtual machines by querying an electronic database that electronically associates the virtual machines to blockchain parameters including the parameter associated with the corresponding blockchain;
- load balancing the virtual machines to the blockchains by executing a blockchain load balancing mechanism that assigns the virtual machine to the corresponding blockchain;
- sending the corresponding blockchain to the virtual machine for the processing.

9. The system of claim **8**, wherein the operations further comprise receiving blockchain transactions associated with the corresponding blockchain.

10. The system of claim **9**, wherein the operations further comprise determining a number of the blockchain transactions associated with the corresponding blockchain.

11. The system of claim **10**, wherein the operations further comprise assigning the virtual machine to the corresponding blockchain based on the number of the blockchain transactions associated with the corresponding blockchain.

12. The system of claim **8**, wherein the operations further comprise receiving cryptographic coinage transactions associated with the corresponding blockchain.

13. The system of claim **8**, wherein the operations further comprise determining a bit rate associated with the corresponding blockchain.

14. The system of claim **13**, wherein the operations further comprise assigning the virtual machine to the corresponding blockchain based on the bit rate.

15. A memory device storing instructions that when executed by a hardware processor perform operations, the operations comprising:
- receiving the blockchains as inputs;
- determining a parameter associated with a corresponding blockchain of the blockchains;
- identifying a virtual machine of the virtual machines by querying an electronic database that electronically associates the virtual machines to blockchain parameters including the parameter associated with the corresponding blockchain;
- load balancing the virtual machines to the blockchains by executing a blockchain load balancing mechanism that assigns the virtual machine to the corresponding blockchain;
- sending the corresponding blockchain to the virtual machine for the processing; and
- generating a blockchain data layer that records the blockchain load balancing mechanism assigning the virtual machine to the corresponding blockchain.

16. The memory device of claim **15**, wherein the operations further comprise receiving blockchain transactions associated with the corresponding blockchain.

17. The memory device of claim **16**, wherein the operations further comprise determining a number of the blockchain transactions associated with the corresponding blockchain.

18. The memory device of claim **17**, wherein the operations further comprise assigning the virtual machine to the corresponding blockchain based on the number of the blockchain transactions associated with the corresponding blockchain.

19. The memory device of claim **15**, wherein the operations further comprise receiving cryptographic coinage transactions associated with the corresponding blockchain.

20. The memory device of claim **15**, wherein the operations further comprise:
- determining a bit rate associated with the corresponding blockchain; and
- assigning the virtual machine to the corresponding blockchain based on the bit rate.

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